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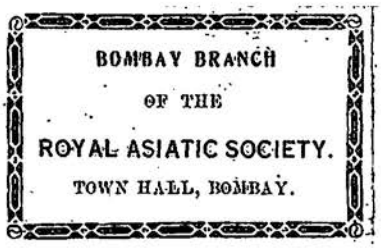

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GOVERNMENT OF INDIA

DEPARTMENT OF INDUSTRIES AND SUPPLIES

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REPORT

OF THE

PANEL ON ARTIFICIAL SILK AND RAYON INDUSTRY

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PERSONNEL.

Chairman—

Dr. Nazir Ahmad, O.B.E., Ph.D. (Cantab), F. Inst. P.

Members—

1. The Hon'ble Sir Shanti Das Askuran.
2. Mr. Gautam Sarabhai.
3. Mr. M. P. Bhargava.
4. Mr. P. N. Sinha.
5. Mr. M. Subba Rao.

Secretary—

Mr. A. S. Bhatnagar, Assistant Industrial Adviser.

Mr. R. J. Chinai was subsequently co-opted as a member of the Panel.

INTRODUCTORY REMARKS.

The Government of India in the Department of Planning and Development constituted a Panel to consider and advise them regarding the establishment of artificial silk and rayon industry in India in the post-war period.

General Directive.

II. The following general directive was issued by the Government of India to indicate the scope of the Panel and the procedure to be followed by it.

1. It is the function of panels to make recommendations to Government regarding the development of industries, both existing and new. These recommendations should be so framed as to enable Government to prepare a detailed phased plan for the five years following the cessation of hostilities, as the first stage of a 15-year plan of industrial development for the whole country.

2. In order to assist them to formulate recommendations, panels will be supplied, as far as possible, with factual information prepared by the panel secretaries. In the case of new industries, the information will consist of a general survey of the industry and the importance of starting it in India, the availability of raw material, the power requirements, the demands of the Indian markets and the probabilities of exports. In the case of existing industries, the information will naturally be more comprehensive; it will indicate in addition, the location of existing units, the types of goods produced, the total production under each category and the assistance, if any, given by Government. These items are to be regarded as illustrative and not exhaustive.

Government will give each panel, as a basis, for discussion, the provisional target to be aimed at in the first five-year period and, wherever possible, of the target to be reached in 15 years.

3. The recommendations of the panels should cover the following points :—

(1) The scope and extent of development, including the type of products recommended,

(1-A) The estimated requirements of capital goods together with such details of those requirements as may be available in India and how much should be imported from abroad.

(2) Whether the industry should be under Government ownership either on grounds of national interest or because private capital is unlikely to take it up, and if so, whether it should be wholly or partly managed by Government.

(3) In the case of industries to be developed other than under State ownership, the capital required for such development, whether the whole of it is likely to be available by public investment and, if not, the extent to which Government assistance may be required.

(4) The extent to which technical advice from abroad may be necessary.

(4-A). The availability and the future requirements of technical personnel so as to obtain a clearer indication of the present short-commings and future needs.

(5) The manner and the degree of co-operation with foreign firms considered necessary and desirable, both as regards capital and management.

(6) The location of the industry.

(7) The nature of the assistance required from Government in the form of protective duties, bounties research grant, expert advice, etc.

(7-A) The relative incidence of the import duty on the finished goods in comparison with the duty on the raw materials from which they can be manufactured.

(8) If the industry is to be under private ownership and management, what controls, if any, should be exercised by Government.

(9) What should be the organisation of the different units of the industry, e.g., should there be an industrial association ? Would a cartel be desirable ?

(10) The stages by which the industry should be developed.

(11) Should the industry cater for the export market ?

(12) Should the industry be developed, as in Japan, on the cottage industry basis and, if so, to what extent ?

4. Although, as stated above, the panels may recommend the grant of protection, it will not be their function to consider broad questions of international trade and commercial policy.

5. Joint meetings of the panels should be held, wherever necessary, to secure co-ordination particularly where the processes and products of one industry are connected with those of another.

6. Some of the panels have been drawn broadly and it may be necessary to co-opt members for dealing with specific branches of the industry. Members may be co-opted by the Chairman in consultation with the Industrial Adviser.

7. Before submitting recommendations, panels should consult Provincial Industrial Committees, particularly in the matter of location of industry. They should also, where the circumstances of the case require it, consult Industrial Committees in States or State Governments-Durbars. The recommendations should be submitted to Government through the Industrial Adviser.

BREIF ACCOUNT OI PANEL'S WORK.

III. A preliminary note containing factual information about the industry was prepared by the Secretary and circulated amongst the members of the Panel before its first meeting.

IV. The panel met on the following dates :—

(*a*) First meeting held on the 2nd and 3rd July 1945 at Bombay.

(*b*) Second meeting held on 28th and 29th August 1945 at Bombay.

(*c*) Third meeting held on the 12th, 13th and 14th February 1946 at Bombay.

(*d*) Joint meeting with representatives of Provincial and State Governments and their Industries Committees held on the 11th July 1946 at New Delhi.

(*e*) Fifth meeting held on the 18th September 1946 at New Delhi.

(*f*) Sixth meeting held on the 29th November 1946 at Bombay.

V. The Panel sought the advice of the following persons and representatives of associations at various stages of its deliberations :—

1. Dr. L. Thoria, Dr. Ing. (Germany), Bombay.
2. Mr. Ganga Raju.
3. Mr. DuPlant, Engineering Consultant, Bombay.
4. Sir Frederick Stones of M/S E. D. Sassoon & Co., Bombay.
5. Mr. Henry Kohorn of M/S. Oscar Kohorn & Co., New York.
6. Mr. Watson of M/S Duncan Straiton & Co., Bombay.
7. Mr. Sankal Chand G. Shah—*Vice President* } Representatives of All
8. Mr. Morarji J. Vaidya—*Hony. Secretary* } India Manufacturers
9. Dr. A. Nagaraja Rao—*Chairman (Heavy Chemicals Sub Committee).* } Organisation, Bombay
10. Mr. M. L. Badami— *Secretary.* }
11. Mr. Dhiraj Lal Schroff, Millowner, Bombay.
12. Mr. S. G. Sastry, Retired Director of Industries, Mysore.
13. Mr. R. P. Dessai, Technical Expert, Bombay.
14. Mr. I. P. Parikh of M/S Podar Sons Ltd., Bombay.
15. Mr. M. L. Narasimiengar, Chairman, Mysore Paper Mills Ltd., (Mysore State).
16. Dr. K. A. N. Rao, Deputy Industrial Adviser to the Government of India.
17. Mr. T. Blackburn of M/S Dobson & Barlow Ltd., England.

ACKNOWLEDGEMENTS

The Panel is greatly obliged to these gentlemen and several other officials and non-officials for their willing help and valued advice.

VI. Grateful thanks of the Panel are due to the Chairman for his able guidance at the meetings and for his keen interest in the work of the Panel.

VII. The Panel wishes to place on record its appreciation of the services rendered by the Secretary, Mr. A. S. Bhatnagar, in the collection of statistics, preparation of draft report and other duties connected with the work of the Panel.

ARTIFICIAL SILK & RAYON INDUSTRY

Earlier Developments—The story of the development of artificial silk forms one of the most romantic chapters in the history of industrial research. After a long preliminary period of patient research, the artificial silk industry started in 1895—in France, the process employed being the Chardonnent process. There was an initial period of uncertainty, after which the world output rapidly increased from a few hundred thousand lbs. in 1896 to 22 million lbs. in 1913. The constant improvement in the quality of the new fibre, the multiplication and extension of its uses, its cheapness and increasing familiarity of manufacturers with its possibilities, combined to produce a continued increase in the demand of artificial silk goods. Fashion in wearing apparel and the general prosperity of the working classes also favoured the more extensive use of this synthetic fibre. As the term artificial silk gave rise to misdescription and confusion, the American trade decided in 1924, to take the lead in discarding this title in favour of the neater and more comprehensive word "rayon". British firms followed suit in 1928.

2. *Types of rayon and modern trend.*—Various processes have been employed for the manufacture of rayon in industrially advanced countries such as the cup rammonium process, the cellulose nitrate process etc., but the two more popular methods which have gained prominence and are in vogue are :—

(1) the viscose process ;

(2) the acetate process.

The more common of these two is the viscose process, which on account of cheapness in the finer deniers, contributes to more than 80% of the total world production of rayon. The U. S. A. production of 573 million lbs. in 1941 consisted of approximately (1) viscose 63%,(2) acetate 32%, (3) cuprammonium 2%.

One great advantage that viscose rayon scores over acetate rayon is its ability to take the same dyes as used for cotton. Unlike viscose rayon, which is regenerated cellulose, acetate threads consist of cellulose acetate and a special class of dyes is required for them.

3. During recent years, however, there has been a great demand for union fabrics in the United States of America. These fabrics are manufactured out of mixed acetate and viscose yarns. This trend along with recent advances that have been made in the dying processes have given a great impetus to the acetate rayon industry, and production of acetate rayon is steadily mounting up in the States and other European countries. The acetate industry has one special advantage. Its finished product which is cellulose acetate can be used for many purposes such as rayon, plastics, lacquers, etc. On the other hand staple fibre is made almost exclusively from viscose. The synthetic fibre industry is undergoing radical changes in Western countries and every day new fibres are being perfected. Many other synthetic fibres like Nylon and Vinyon are becoming popular and their use is finding favour in other countries particularly in the United States of America.

4. *World production of Rayon.*—The total world production of rayon yarn in 1942 reached the high figure of 1,447 million lbs. as compared to 48·2 million lbs. in 1921 (App. I). America has been the top manufacturer of rayon in the recent years. Its production of rayon was 479 million lbs. in 1942 as against a meagre production of 18 million lbs. in 1921. England, too, has made rapid progress in rayon manufacture. Its total production in 1942 has been estimated at 90 million lbs. (App. I). Rayon has not only been successfully competing with cotton and genuine silk but has largely replaced them from the markets in Germany, France and Italy. In these countries it is believed that more than 50% of the clothing is made out of rayon. The production of rayon in Germany, Italy and France was 160, 119 and 56·2 million lbs. respectively in the year 1939 (App. I). The estimated production of 1942 for these countries was 220, 132 and 69·5 million lbs. respectively. The greatest advance in the production of rayon has, however, been made by Japan. With a relatively small production of 3·2 million lbs. in 1925 its production rose to 239·3 million lbs. in 1939 (App. I). This country flooded the world markets with large quantities of rayon yarn and fabrics which were available at amazingly low prices. The estimated rayon yarn production in 1942 was 300 million lbs. which were only second to U. S. A.'s estimated production of 479·3 million lbs. (App. I). Methods of production employed in Japan are kept secret but it is stated that among other raw materials they employed pulp from the coniferous trees growing in Manchuria.

5. *World Production of Staple Fibre.*—Despite a late start, staple fibre which is the name given to predetermined and equal lengths cut from rayon tow, has already passed the rayon yarn in the volume of world production. The world staple fibre production for 1942 was 2,026 million lbs. as compared to the yarn production of 1,447 million lbs. (App. II). The use of staple fibre has gained prominence because it can be used in admixture with natural fibres such as cotton and wool. It has been possible to work it on textile and woollen machinery with slight modifications. The American production of staple fibre in 1942 was 153 million lbs.

The estimated production of staple fibre in England, Japan, Germany and Italy in 1942 was 45,400,880 and 330 million lbs. respectively (App. II). The kind of rayon staple which has so far achieved the greatest volume both in United States of America and throughout the world is the viscose staple. So far it has been the cheapest form of rayon staples and attained peak production just before the war.

Case for the Establishment of the Industry in India.

6. *Consumption of Rayon in India.*—India is one of the leading textile manufacturing countries in the world. In 1941-42, the textile production in the country was 4,495 million yards as compared to 1,164 million yards just before the First World War. With the increase in production there has been a corresponding increase in the varieties of fabrics manufactured and Indian textile mills have been importing long staple cotton from the U. S. A., Uganda and Egypt etc., in order to produce better and finer qualities. The advent of rayon brought a further increase in varieties of fabrics and Indian textile and silk mills began to import increasingly large quantities of rayon yarn. Import figures of rayon yarn in India (App.III) showed tremendous rise from a

relatively small quantity of about 0·4 million lbs. imported in 1923-24, to 33·9 million lbs. (valued at Rs. 265 lakhs) in 1940-41. The total value of the imports of rayon yarn and manufactures was Rs. 544 lakhs in 1940-41 and Rs. 349 lakhs in 1941-42, the decrease being due to war conditions. Japan supplied over 93% of our requirements in 1940-41 and about 85% in 1941-42 (App. IIIa).

7. Imports of piece-goods made entirely of rayon were 53·3 million yards valued at Rs. 245 lakhs in 1940-41 and 27·7 million yards valued at Rs. 168 lakhs in 1941-42. Imports of goods of rayon mixed with other fabrics totalled 4·8 million yards valued at Rs. 28 lakhs during 1940-41. With the import of rayon yarn a number of rayon weaving factories were set up in the country. An attempt was made to obtain a complete list of the rayon weaving factories in India. The information so far as made available to the Panel is given in Appendix IV, but it may be presumed that this does not represent a complete list of all the rayon weaving factories installed in India. In addition to the weaving factories using imported rayon yarn for making rayon fabrics, many cotton mills in India are now using fairly large quantities of rayon yarn in the manufacture of saree borders and other union fabrics. The use of rayon yarn in combination with cotton yarn has also spread to the handloom industry, and a very large number of handlooms are successfully functioning in the country. An estimate made in an article published in the December (1944) issue of the "Eastern Economist" puts the capital invested in the rayon weaving industry in India at about Rs. 2½ crores and the annual production at about 50 million yards of rayon cloth. It is estimated that not less than 8,000 power loom for rayon weaving are installed in the country.

8. India is a poorly clothed country. The consumption of cotton per head in India was only 3·5 lbs. in 1935 as compared to 23·1 and 17·3 lbs. in U.S.A. and England respectively in 1937 (App V). Similarly the per capita rayon consumption in our country was only 0·10 lbs. in 1935 as compared to 2·88 lbs. and 2·51 lbs. in U. S. A. and England respectively in 1937. Germany led the world in her per capita consumption of rayon, the figure being 6·49 lbs. per head. Japan was a close second with 5·30 lbs. (App. VI).

Post-War plans for this country are all directed towards increasing the per capita income of the people with a view to raising the standard of living. Better food and clothing should be the first consideration of every plan. This will naturally lead to increased consumption of rayon clothing in the country.

9. India is very favourably placed for the establishment of the rayon industry. In the first instance the large pre-war consumption and the anticipated post-war increse in themselves warrant for its immediate establishment. Besides this, almost all the raw materials required for its manufacture are or can be made available in the country in abundance. The case for the establishment of rayon industry in India assumes an added significance under the present coditions, because it is expected that Japan which supplied a major portion of India's rayon requirements in the pre-war period will not be able to offer severe competition for many years to come. In view of the above considerations and the fact that India should be self sufficient in her domestic

requirements, this Panel is strongly of the opinion that the immediate establishment of this important industry in the country is essential in the post-war period. Our pre-war consumption of rayon was between 60 to 70 tons per day. In order to cover the pre-war demand by indigenous production, the Panel is of the opinion that there is easily room for 6 to 7 rayon factories (each having a daily production capacity of 10 tons) in India in the immediate post-war period with a possible addition of another 4 to 5 factories as our requirements increase owing to an increase in population and rise in the standard of living.

The Panel visualises that there will be a steady increase in the consumption of rayon in the country, mainly due to the following two reasons :—

(*a*) increase in population, which can be estimated with fair accuracy,

(*b*) rise in the standard of living, an estimate for which is difficult to make at present.

The extent of increase in rayon consumption will depend upon the rise in the standard of living, cost of its production and such foreign competition as might be anticipated in the post-war period.

10. Units of 5 tons and 10 tons production capacity per day which are considered as economcial, are considered most suitable for this country in view of the need of developing the different regions and spreading out factories over a wide area. However, if other conditions are favourable, there should be no objection to the installation of bigger plants so as to reduce the overheads, etc.

The Panel is of the opinion that six out of these seven factories should be for the manufacture of viscose rayon (yarn and staple fibre) and in view of the modern trend of increased use of the union fabrics, at least one factory should be for the manufacture of acetate rayon. It should be remembered in this connection that our country is very favourably placed with ragard to certain raw materials such as cotton waste, molasses (for acetic acid) etc. required for the acetate industry and extensive research work should be initiated to develop this industry.

The need for carrying out operations on a pilot plant basis are dealt with in paragraph 16. It is realised that even after this stage has been accomplished certain problems will have to be solved in actual factory operation since it is a new industry in India.

11. *Raw Materials.*—Cellulose is the main raw material required for the manufacture of viscose and acetate rayon. India abounds in cellulose bearing materials—cotton, bamboo, woods, bagasse, jute, reeds, sun hemp, akra floss, etc.

12. *Cotton.*—Cotton is the purest form of cellulose among the natural products. Chemical cotton which is the name given to chemically cleaned cotton contains over 99% alpha cellulose.

The cheapest source of chemical cotton is cotton linters. The actual production of linters in India before the war was estimated at about 15,000 bales of 400 lbs. each. This production, however, was far short of the potential supply as large quantities of cotton seeds, especially of the hirsutum variety were not delinted. It is difficult to make an estimate of the total potential

production of linters in India, but it is estimated, even if a fairly large proportion of the linter bearing seeds of the Indian varieties were delinted, about 75,000 bales of linters representing about 30 million lbs. would be available annually. Cotton linters constitute the principal cellulosic raw material in the manufacture of acetate rayon and 1 lb. of the latter requires 0·7 lb. of cotton cellulose. Allowing for a waste of 40% (includingmoisture) in the prepartion of cotton cellulose from linters it would appear that nearly 5 million lbs. of linters would be required for an acetate rayon factory having a production of 5 tons of acetate rayon per day. Thus, the potential production of linters in India is well in excess of the requirements of an acetate rayon factroy. The balance of linters can profitably be used in combination with wood pulp in the viscose rayon factories to be established in India, and for the manufacture of plastics, lacquers, explosives, etc. It is well known that in America a very large and flourishing linter industry has been built up which supplies its material not only to the rayon industry but also to several other industries such as explosives, plastics, lacquers etc. The Technological Laboratory of the Indian Central Cotton Committee has carried out an investigation on the grades, alpha cellulose content, etc. of Indian linters of two seasons, and the results of this investigation are published in a bulletin entitled "The Analysis, Grading and Utilisation of Indian Linters" by L. Thoria and Nazir Ahmad. The prices of linters prevailing at the time and the technical data obtained for them taken from the bulleting referred to above, are given in Appendix VII. The Panel very strongly recommends that early steps should be taken to make a survey of the potential supply of Indian linters and every assistance should be given by the Government for the installation of delinting plants at the oil mills and other centres for extracting linters from seeds before they are either pressed for oil or exported out of India. In this way not only a valuable raw material will be available for the development of several industries in India in which the linters are used as the basic material, but also the cultivators of cotton would be able to get a little higher price for their seeds.

In addition to these linters a very large quantity of cotton waste is available from the Indian cotton mills. While some of this waste is undoubtedly useful for spinning lower counts, other types of waste such as blow room droppings, cardfly, etc. are eminently suitable for conversion into chemical cotton. Thus taking the linters and lower grades of waste into account India would seem to possess abundant supplies of cotton cellulose for the rayon industry. Cotton cellulose is almost exclusively used in the manufacture of acetate silk, while in the manufacture of viscose silk it is mixed in varying proportions upto about 30% with cellulose obtained from wood pulp.

13. *Wood pulp and other pulps.*—The cellulosic content of wood pulp, which is the principal cellulosic raw material used in the manufacture of viscose rayon, is about 90% which means that a factory having a production of 5 tons of viscose rayon per day will require about 5·5 tons per day of wood pulp. In European countries and in the United States of America, originally, soft wood such as spruce and fir, was used as the chief cellulose bases for the manufacture

of viscose rayon. Later on these pulps have also been made from the southern pine, which is relatively hard, and are of equally good quality. The Scandinavian countries are among the principal suppliers of soft wood pulp to England and other neighbouring countries, while in Italy, rayon was said to be manufactured from a special variety of reeds known as Arunda Donax which is found abundantly in Assam. It has been stated sometimes that India does not possess large quantities of soft wood suitable for rayon. The Paper and Pulp Section, Forest Research Institute, Dehra-Dun are, however, of the opinion that abundant supplies of spruce and fir-wood are availabe in the Kashmir and Tehri-Garhwal forests. Attempts should be made to explore the possibilities of their economic transport to the plains by the more recently developed methods of transport.

14. *Bamboo.*—The experiments carried out at the Technological Laboratory, Indian Central Cotton Committee, Bombay, under the auspices of the Council of Scientific and Industrial Research have shown that bamboo, of which we have abundant supplies available in different parts of the country, may prove to be a very promising material for rayon. The Eta type of bamboo grown in Travancore State has yielded a good quality pulp with high alpha-cellulose content and low ash content. It is understood that before the war some samples of bamboo grown in the Karnatak forests (Bombay Province) were sent to Germany for tests. The report on these was not available to the Panel but the experiments, carried out in the laboratories of the German Rayon concern Glanz-Staff Fabriken, showed that this material might prove a satisfactory raw material for the manufacture of rayon. It should however be noted that until pilot plant experiments are carried out in which bamboo pulp is actually spun into rayon and the yarn and cloth obtained are given the sizing, dyeing and finishing tests, it is not possible to say definitely whether this material would prove entirely satisfactory when used on a large factory-scale. Such pilot plant tests have to our knowledge not been performed so far, and the Panel has in the latter part of the report recommended that a pilot plant for this purpose should be set up at an early date in India. Bamboo, howeover, posesses an advantage over wood, in that it is a two to five yearly crop, whereas coniferous woods take forty to sixty years before they become suitable for use as pulp wood. The cellulose content of bamboo is very nearly the same as that of wood, but the ash content of the pulp made from it is found to be somewhat higer than that of the imported wood pulp. This may lead to some difficulties in the spinning process such as clogging, but it should be mentioned in this connection that the ash content of the pulp can be reduced to some extent by physical and chemical treatment. Whether such treatment would be able to reduce the ash content to a limit at which pulp made from bamboo would be found quite suitable for rayon manufacture can only be ascertained by experiments on a pilot plant, which is an additional argument in favour of the installation of such a plant in India at an early date, if this promising raw material is to be fully exploited for the rayon industry.

Pre-war average price of bamboo in India ranged between Rs. 16 to Rs. 18 per ton delivered at factory site. In certain areas it was even available at about Rs. 12 per ton. It is reported that in 1938, the cost of one ton of bleached bamboo pulp suitable for paper manufacture, worked out at about Rs. 140 per

ton. Against this the price of imported bleached sulphite wood pulp, excluding the protective duty, was about Rs. 100 per ton. The present price per ton of imported bleached sulphite wood pulp from the U. S. A. is over Rs. 360 per ton delivered at port. With the aid of the protective duty, bamboo has established itself firmly in the Indian paper industry and has fair chances of being successfully used as the cellulose base in viscose rayon manufacture. Extensive research should, however, be carried out to standardise the technical details of making bamboo pulp suitable for rayon manufacture.

15. *Bagasse.*—Bagasse is yet another promising raw material, as it contains a good percentage of cellulose. The experiments carried out on the manufacture of bagassed pulp by the nitric acid treatment method, have shown that the pulp so obtained is quite satisfactory as regards the alpha cellulose content but contains a slightly high percentage of ash. The technical details of pulping bagasse have still to be worked out. It is quite possible that with the aid of further research and recent developments in the technical processes of pulping, bagasse may prove to be a suitable raw material for the manufacture of rayon. At present bagasse is being utilised as a fuel in the sugar mills, which is however not its proper use. About 2 million tons of bagasse are available from the sugar mills every year.

In addition to the above mentioned raw materials, we have abundant supplies of other cellulose bearing materials, such as hemp, reeds, grasses, etc. A preliminary survey of the cellulosic bearing raw materials of India has been carried out by Nazir Ahmad and Karnik under a scheme financed by the Council of Scientific and Industrial Research, and the results obtained have been published in the Journal of Scientific and Industrial Research in its issue of June 1944. It is necessary that this work should be followed up and extensive research should be undertaken to explore the possibilities of their use in rayon and other industries.

16. It will therefore be seen that India is very favourably placed with regard to cellulose which is the basic raw material for rayon manufacture, although extensive research work has to be carried out to work out the technical details, to estimate the cost of manufacture of the pulp and to standardise the quality of pulp made from the indigeneous raw materials. Authoritative statistical data about the total quantity of these raw materials available for pulping purposes is also not available. Under these circumstances the Panel is definitely of the view that in the initial stages at least it would be necessary to use imported wood pulp in the rayon factories to be established in India. The wood pulp suitable for rayon manufacture is made in special qualities with regard to alpha cellulose and ash content etc., and until pulp of the right quality can be manufactured in India, the rayon industry will have to depend upon foreign supplies for the basic raw material. This position, however, is fraught with a certain amount of risk, as in war time or due to other causes, these supplies may be completely cut off or considerably curtailed, thereby placing the industry in a perilous state. The Panel, therefore is very strongly of the opinion that the use of indigenous materials should be encouraged and developed simultaneously with the establishment of the rayon industry so that India may not remain dependent upon foreign suppliers for an essential

raw material. For the exploitation of the Indian raw materials the Panel makes the following recommendations :—

(1) As no reliable statistical data on the availability of cellulose raw materials is available, the Government is requested to arrange for the carrying out of an immediate survey of all cellulosic raw materials including soft and hard wood, bamboo, grass, other reeds, cotton linters, cotton wastes etc., available in the country. This survey should be carried out through the Department of Agriculture, Government of India, who should appoint special forest officers in the different regions for collection of statistical data and should be given a special grant for this purpose. For carrying out this survey priority should be given to those regions where the location of new units is indicated by the Panel or where the natural resources are available in plenty.

(2) In view of the facts that (*a*) rayon manufacture is a highly specialised industry, (*b*) the utilisation and exploitation of the Indian raw materials have not been systematically studied, (*c*) the costs of manufacture under Indian conditions have not been properly worked out, it is essential that Government should take steps to establish a semi-comercial plant of a capacity of about 100 lbs. per day for preparing the pulp and about 100 lbs. per day for spinning the yarn, complete in every respect. The installation of a complete pilot plant is also necessary from the consideration that the mere knowledge of the physical and chemical properties of a pulp is not sufficient to determine its suitability for rayon manufacture, which can only be ascertained by performing an actual spinning test, followed by the dyeing and finishing processes. The proposed pilot plant will not only materially help in the solution of the above problems and other technical research problems of the industry but will also assist in creating confidence in the public mind.

17. *Chemicals.*—The chemicals required in the manufacture of rayon are:

Viscose rayon—

1. Caustic soda.
2. Sulphuric acid.
3. Carbon disulphide
4. Glucose and other sizing materials.
5. Sodium sulphate.
6. Sodium sulphite.
7. Sodium sulphide.
8. Zinc sulphate.
9. Zinc oxide.
10. Sodium hypochlorite.
11. Hydrochloric acid.
12. Formic acid.
13. Softening oils.

Acetate rayon.—

1. Acetic acid.
2. Acetic anhydride.
3. Acetone.
4. Sulphuric acid.
5. Softening oils & sizing materials.
6. Sodium acetate.

It is interesting to note that the manufacture of 5 tons of viscose rayon requires the use of about 20 tons of chemicals. The following approximate quantities of chemicals (as supplied by a British manufacturer) are required for the production of 1 ton of viscose rayon.—

	(In tons)
Wood pulp	.. 1·200
Caustic soda 99%	.. 1 000
Carbon bi-sulphide	.. 0 350
Sodium sulphite	.. 0 073
Dialysing material	.. 0 00052
Sulphuric acid 77%	.. 1·650
Zinc oxide	.. 0·017
Glucose 80%	.. 0 037
Sodium sulphide 66%	.. 0·100
Formic acid 66%	.. 0·012
Soft finish	. 0.0025

18. It can be seen that the development of the Rayon industry is closely linked with the development of the heavy chemicals industry in India and the location of rayon plants should take into account the facilities available for the manufacture of these major chemicals near the sites. It is essential that the rayon plants should have plants for the manufacture of carbon-bisulphide on the spot as this chemical is somewhat inflammable and cannot be safely transported from one place to another. It would also be desirable if the rayon plants especialy the bigger units had their own plants for manufacturing sulphuric acid at or near the factory thereby saving freight charges, middlemen's profits, etc. It is estimated that the cost of a contact process sulphuric acid plant capable of satisfying the requirements of a 5 ton rayon plant would be in the neighbourhood of Rs. 3½ lakhs, which is a small proportion of the capital required for the rayon machinery. The cost of production of the sulphuric acid at the rayon factory will in all probability, be lower than the market price owing to savings in overheads and profits. It may also be an advantage to have the caustic soda plant at or near the rayon factory so that the caustic soda liquor can be supplied in drums which would not only save freight but also the expenses on converting it into sticks or flakes and redissolving it. Since, however, the manufacture of caustic soda is linked up with the manufacture of almost an equal quantity of chlorine, which is not wholly required in the rayon industry and for which a separate market has to be found, the problem of locating the caustic soda factory, as a part of the rayon factory is not so simple as that of carbon-di-sulphide and sulphuric acid. It has to be examined from a different angle especially from the point of view of the marketability of chlorine and its subsidiary products such as bleaching powder. Regarding the location of the caustic soda plant at the site of the rayon factory the Panel feels that each case should be decided on its own merits. For factories located near large chemical producing centres like Bombay and Calcutta, it may not be necessary for rayon manufacturers to produce their own caustic soda, while for rayon factories situated at places far away from these centres it will be a distinct advantage to instal caustic soda plants at the sites. Since large quantities of chlorine will be made available by the installation and working of the electrolytic plants for manufacturing caustic soda, the Panel strongly

feels that Government should extend the use of chlorine for public health purposes and also for the manufacture of D.D.T. and plastics etc. The attention of the Heavy Chemicals Panel is drawn to this recommendation. In connection with the chemicals required in the manufacture of rayon, it should be noted that in many cases, chemicals of commercial purity will not serve the purpose, and they must be of a high degree of purity satisfying certain specifications arrived at as a result of extensive research and long experience by the industry. For example, the caustic soda used in the rayon industry should have a chloride content not exceeding 0·2 per cent while its chlorate content should be practically nil. This can be achieved by further purification of the caustic prepared in the diaphragm type electrolytic cells or directly in a mercury electrolytic cell. Similarly, the purity of glucose should be of the same standard as demanded in the baby food industry. The water used in the washing and other processes should be soft and free from iron, while sulphuric acid and sulphates required by the industry should be of high grades of purity. This aspect of the problem therefore assumes special significance, and should be carefully considered, when plans are made for installing the plants for the manufacture of chemicals required by the rayon industry. Furthermore, in view of the large quantities of chemicals used in the manufacture of rayon, the Panel feels that there should be a close co-ordination in the execution of the plans and recommendations of this Panel with those of the Heavy Chemicals Panel, especially in regard to the location of the factories where the question of the availability of chemicals of the right quality assumes special significance. The position regarding the production of the different chemicals for rayon manufacture in the country is as follows :—

19. *Caustic soda.*—Caustic soda is one of the basic chemicals used in several important industries such as textiles, paper, soap, explosives, dyestuffs, vegetable oils, etc. On the basis of unrestricted off-take our present consumption of caustic soda is about 54,000 tons annually. The present production capacity of the Indian factories is about 5,700 tons per year rising upto 11,700 tons in 1948-49, while with the installation of 4 electrolytic plants which have been ordered from abroad, it may go upto about 19,000 tons. Even with this increase the Indian manufacture of caustic soda will be far short of the country's demand which is estimated at about 70,000 tons per annum. The six units of rayon when installed will require an additional supply of about 30,000 tons of caustic soda per annum, which will have to be met with either from imports or by the installation of additional plants.

20. *Sulphuric acid.*—The production of sulphuric acid is rightly said to be the index of a country's industrial development. The production of sulphuric acid in India in pre-war days was estimated at about 26,000 tons per annum. This quantity was supplemented by imports. The present war has given a great fillip to this industry on account of its increased demand for defence requirements. The present production is estimated at about 60,000 tons per year calculated in terms of 100% strength. The rayon industry will require about 34,000 tons of sulphuric acid.

In addition, large quantities of sulphuric acid will be required by other industries which are numerous in number and which are proposed to be established in the post-war period. It is, therefore, necessary that the requirements

of the rayon and other industries in regard to sulphuric acid in the post-war period should be taken into account while preparing plans for the development of this industry in India. The manufacture of sulphuric acid in India depends primarily upon the unrestricted supply of sulphur at competitive rates. In the opinion of the Panel therefore, it is essential that the Government should pay special attention to this point and should make due provision for the supply of adequate quantities of sulphur of a high degree of purity at fair prices to the Indian manufacturers of sulphuric acid. Furthermore, the high prices charged at present by the Indian manufacturers for sulphuric acid, which enjoys a virtual protection owing to transport difficulties, act as a severe handicap to the development of all industries including rayon in which this chemical is used. These prices bear little relationship to the prevailing price of sulphur, and are considerably higher than those at which sulphuric acid is made available to the industrialists in other countries such as England and the U.S.A., thereby placing them at a definite advantage. The Panel strongly feels that Government should look into this question at an early date with a view to stabilising the price of sulphuric acid at a reasonable level and making it available to the consumers at this price.

21. *Sizing Materials and other Chemicals.*—Before the war, glucose and other sizing materials were all imported from abroad, the total quantity of sizing materials imported being in the neighbourhood of 100,000 tons per annum. During the war many factories, large and small sprang up in different parts of the country and were able to satisfy the requirements of the textile industry which were curtailed to about half the pre-war level by means of control orders. If these control orders continue and the position as regards certain foodgrains from which starch is made, improves these factories would be able to supply the demands of the Indian textile industry. If the seven units of rayon industry, however, are established according to the recommendations of the Panel, they will require another 10,000 tons of sizing materials per annum. Furthermore, if the control orders restricting the use of sizing materials, are relaxed, there will be an increased demand for the sizing materials for which additional factories will have to be established if India is to supply the total requirements of this commodity. Therefore in making plans for the establishment of sizing materials industry, the future requirements of the textile industry plus the requirements of the rayon industry amounting to about 10,000 tons per annum should be taken into consideration.

22. *Acetate Rayon Chemicals.*—The Indian production of acetic acid before the war was confined to the wood distillation industry in Mysore with a capacity of about 200 tons per annum, but the actual production came to only 50 to 60 tons, which was being sold as calcium acetate. During the last two or three years they were supplying the calcium acetate to the Ordnance Factory at Arvarkadu for manufacture of acetone. As the Ordnance Factory has now installed its own plant, Mysore has again started manufacturing acetic acid. Hyderabad Chemical and Fertiliser Co., have recently set up a plant of about 150 tons capacity, while the Bhadravati plant in Mysore is being extended to bring the production upto 300 tons per annum. The production of acetic acid can be greatly increased in the post-war period. Alternative methods of production of acetic acid from (1) calcium carbide, (2) oxidation of alcohol, should also

be investigated. With the development of the hydro-eolectric projects in the post-war period the calcium carbide method of manufacturing acetic acid presents bright prospects. As regards the other source of acetic acid many sugar mills have already installed fairly large sized distilleries in which alcohol is produced from molasses. Under suitable conditions it can be oxidised to give acetic acid, but the economic aspect of this method must be carefully worked out. The production of power alcohol is bound to increase as other distilleries are set up in the country, and a part of it can be utilised for the manufacture of acetic acid. There has been no production of acetic anhydride in the country on a commercial scale, but it is understood several Indian industrialists are exploring the possibilities of manufacturing acetic acid from molasses or alcohol.

23. *Acetone.*—Acetone has been manufactured on a very small scale in India. The Arvankadu Ordnance Factory was producing 14 tons of acetone per month from calcium acetate, but it has now set up a plant for manufacturing 75 tons of acetone per month from alcohol. Their output however may not be available for civilian needs. With the development of the power alcohol and wood distillation industries in India, the production of acetone is bound to increase as it has many other uses. The requirements of an acetate rayon factory will be in the neighbourhood of 2,500 tons per annum, provided a suitable recovery plant for acetone is installed. In this connection it may be noted that the success of an acetate plant depends upon the efficiency of the recovery plants both for acetone and acetic acid.

24. The Panel feels that there are good prospects for developing the acetate industry in India for which the chief raw materials such as cotton linters, cotton wastes, molasses, power alcohol etc., are abundantly available in the country. Apart from the acetate rayon which is finding increasing use in U.S.A. especially in the union fabrics, this industry will be a feeder to many other important industries such as plastics, lacquers, cinema films, etc. It is, however, necessary in the opinion of the Panel that the technical and economic aspects of the acetate industry, including the manufacture of chemicals required for it, should be thoroughly investigated on a pilot plant scale for which the necessary funds should be found by the Government.

25. *Uses of Rayon.*—The earlier uses of rayon were as a substitute for natural silk in certain fabrics, i.e., the fabrics were woven with rayon weft and silk warp and vice versa, thus lowering the cost of the materials. With the development of new methods and machinery and with a growing realisation of its characteristic qualities the use of rayon has gradually extended to every variety of textile. It is difficult to enumerate all the different types of goods in which it finds use, but the more important ones include sarees, shirtings, suitings, underwear, hosiery especially in admixture with other yarns, all varieties of embroidery and knitting yarns, neckties, coat linings, brocades, upholstery materials and parachutes. Apart from the continuous filament, the staple fibre, has found an increasingly large use in the textile industry. Beginning with a modest production of 7 million pounds in 1929, its production in 1942 amounted to over 2,000 million pounds, representing nearly 60% of the total rayon production. The staple fibre is uniform in regard to length, fineness, diameter etc. and therefore constitutes an ideal spinning material. In addition, it can be blended with such natural fibres as cotton, wool, silk waste etc., and the blended mixture, or the pure staple fibre, can be spun upon the existing

cotton, wool or silk machines with a few minor modifications. These advantages lend a special charm to it, and it is clear that in view of the highly developed cotton industry in India, any scheme for the establishment of rayon industry in the country must take into account the production of staple fibre on an adequate scale. The last great war has brought the synthetic fibres into prominence, and several new uses of rayon have been found. It has been used (*i*) in the manufacture of incandescent mantles for kerosene lamps, bathing suits, shoes and corset nets, (*ii*) in rubberising rain coats and other military articles, (*iii*) in making self sealing or bullet sealing gasoline tanks, (*iv*) in the manufacture of cords for motor and aeroplane tyres. A table given in Appendix VIII shows the various uses to which rayon has been put in the U.S.A. and the quantities taken up for each line of consumption.

26. *Rayon Machinery.*—There is perhaps no other industry, which has been developed with the same rapidity as rayon. This Industry, though only half a century old, possesses today a vast literature of patents and publications. The improvements that have been made in the process of rayon manufacture, have been both on the mechanical & chemical side of the industry.

One notable improvement that has been made is in the spinning system. Two methods are in vogue (*i*) Bobbin or spiral spinning, (*ii*) Pot spinning. In the first method, as the name suggests, the coagulated thread is wound in bobbins or spirals. In the other system, the coagulated thread is led into a rapidly rotating pot whereby it gets a twist and by centrifugal force collects round the wall of the pot, from where it is removed as a cake. Both methods have their special features but during recent years rayon manufacturers have preferred the use of the pot spinning method.

More recently continuous methods of viscose preparation and rayon spinning have been evolved in America and the Continent of Europe. In Europe emphasis has been laid on continuous steeping and ageing of alkali cellulose whereas in America a continuous system of spinning, which includes bleaching, has been developed in recent years. Both systems are of great interest and specially in respect of the latter there is a reduction in man hours per pound of rayon; but even in America where this system was developed it has been tried only in one factory which is responsible for about 10 per cent of that country's rayon production. It is therefore to be seen how far the continuous process can be universally adopted. The future will reveal whether this system which has significance in countries like England and the United States of America where the rates of pay are high could become economical in India where wages are not so high.

27. The Panel considered the question of supply of rayon plants and the prices quoted for them by the foreign manufacturers. In this connection the Panel had the advantage of considering some quotations quoted by American and British firms which were furnished through the courtesy of members and technical experts who attended the meetings of the Panel. It was generally felt that the prices quoted by the foreign manufacturers were on the high side. It was also felt that the Indian industrialists intending to purchase rayon machinery from abroad should make a thorough examination, with the help of technical experts, of the type, efficiency and

productive capacity of the plants for which the quotations are submitted to them, and provided they are satisfied that the plant would fulfil these conditions, they should try to purchase them at as low a price as possible in order to keep down the capital cost and the depreciation account. Apart from U.S.A. and Great Britain, the possibility of obtaining rayon plants or their component parts, at competitive prices, from other European countries such as Switzerland and France should also be explored. It should be noted in this connection that there are very few firms which fabricate the complete rayon plant, but in most cases the different component parts are manufactured by different manufacturers according to the specifications of the buyers. The Panel, therefore, feels that while an attempt should be made to obtain efficient rayon machinery at the lowest possible cost, foreign technical experts and consulting engineers should be consulted at every stage to ensure that the plant is properly balanced and its various components fit into it in a harmonious manner. The Panel also feels that as long as the present restrictions on exchange prevail, it may not be easy for the Indian industrialists to obtain supplies of rayon machinery from U.S.A. and other foreign countries, and therefore the Panel wishes to urge upon the Government the necessity of relaxing these restrictions at as early a stage as possible in order that quotations may be obtained in a free and competitive market and that the choice of the Indian buyers may not be restricted to certain types of machinery. The Panel strongly urges upon the Government to grant high priority to rayon machinery in the matter of facilities for import of capital goods. The Panel also feels that in the initial stages, until normal conditions return and prices quoted by the foreign machinery manufacturers are brought down to reasonable levels, the rayon industry should be relieved of the import duty on machinery.

28. The total value of plant and machinery required for the industry, calculated on the basis of the present prices quoted by foreign manufacturers (average Rs. 2 crores for a 10 ton unit), is estimated at about Rs. 15 crores for the proposed seven units each of 10 ton daily production capacity. The cost of buildings, erection etc. will be extra.

29. In order to reduce the cost of the plants and encourage the indigenous engineering industry the Panel considered the possibility of manufacturing certain parts of the rayon plants in India. In this connection the Panel sought the advice of two engineering consultants, who were of the opinion that a number of minor parts can be successfully manufactured in India.

It is hoped that a reduction of 10 to 15% can be effected in the cost of the imported capital goods by getting some parts of the plants manufactured in India provided detailed drawings and blue prints from the manufacturers are available. The Panel is of the opinion that in view of the highly technical nature of rayon manufacture, it would be necessary to obtain help and assistance from foreign manufacturers. The Panel further feels that foreign manufacturers supplying the plants to India should send a sufficient number of qualified technicians for erecting and working the plants up to the specified production in the initial stages and should also bind themselves to train a certain number of Indian personnel at their works. The factories when established in India, should give preference to technically trained men, and should guarantee to employ a certain number of such men on adequate terms.

30. *Reparations from Enemy Countries.*—The Panel feels that if, as it is believed likely to be the case, any share of the plants existing in enemy countries should fall to India's share under the head of reparations, the requirements of rayon industry should be kept in view. In particular, it is felt that good use can be made in this country of Japanese rayon machinery. The Panel strongly recommends that at least a few rayon plants should be brought to India by way of reparations, along with foreign experts who should run them in the initial stages. The Panel further recommends that one of these plants, under Government management should be installed for public demonstration and should be worked by foreign experts, so that all the industrialists interested in the establishment of rayon industry in India, should have an equal opportunity of seeing it in actual operation. This plant can also be used for training a certain number of technicians who will be required by the industry, and for carrying out tests on a commercial scale on Indian raw materials, the results of these tests being available to the country as a whole. This measure will greatly help in the establishment of this new industry.

31. *Technical Personnel and Labour.*—The Panel is advised that the following superior technical staff is required for the management of a rayon factory:—

(*a*) One Chief Engineer. (*b*) Two Asstt. Engineers.
(*c*) One Chief Chemist. (*d*) Two Asstt. Chemists.
(*e*) Three Foremen. (*f*) Four Laboratory Chemists.
(*g*) One incharge, Spinning Deptt. (*h*) Two girls for picking the yarn.

For a 10 ton plant, the number of other technical staff required is between 15 to 30. In addition, one analytical chemist in-charge of analysis and tests on raw materials and products at various stages of manufacture is needed. Besides these technical men, about 800 workers will be required for a 10 ton plant. They should be efficient and intelligent as delicate materials have to be handled at various stages. The Panel is of the opinion that suitable arrangements for general as well as technical education should be made by the factories to develop the efficiency and general knowledge of the workers. It is also of the opinion that the factories should put into force definite schemes whereby bonuses or extra wages are given to those workers, who give higher production or show greater efficiency, in order to stimulate the workers to put in their best efforts. Such schemes are now in vogue in the advanced factories in America and Russia and have yielded highly useful results. The Panel suggests that details of such schemes should be obtained from these two countries and circulated to the industrialists to enable them to prepare schemes suitable to Indian conditions.

32. *Location of Industry.*—Regarding the question of general location of industry and sizes of plants, this Panel endorses certain recommendations of the National Planning Committee which are as follows :—

(1) In the matter of location of industries, the claims of the industrially backward areas should be given special consideration, subject to economic considerations justifying the same.

(2) With regard to the location of industries, equal opportunities should be given to every federating unit subject to economic consideration, of employment of labour and development of natural resources, provided similar conditions of work and wages prevail in the unit under consideration.

(3) As regards the size of the units, it is recommended that no unit should be so large as to be outside the reach of competition by smaller but economic units. Units smaller than the economic units should not ordinarily be allowed to be started, except for experimental or pioneer purposes. The size of the economic unit will be decided in the case of each industry by qualified authority.

33. *Dispersion of Plants.*—The dispersion of industry in the different regions of the country is essential for any planned economy. World War II has also shown that large concentration of industry in small areas is full of great risks, as it can lead to the complete destruction of the plants by enemy action especially from the air, thereby dislocating the industrial economy of a country and sapping its power of resistance. The distribution of raw materials and finished products and the employment of labour in the different regions lend further points in favour of dispersal of the rayon manufacturing industry. The Panel, therefore, considers that the rayon factories should be evenly distributed in the different areas taking into account such essential factors as raw materials, markets for finished products, power, transportation, etc.

34. For the successful working of any industrial venture, the selection of a suitable site is of vital importance. For a rayon factory the selection of a site is influenced principally by the following factors :—

(*i*) Availability of pulp and chemicals ;

(*ii*) Abundant supply of water ;

(*iii*) Power and fuel ;

(*iv*) Transport facilities ;

(*v*) Arrangements for the disposal of effluent.

(*vi*) Availability of labour, technical advice and workshop facilities ;

(*vii*) Climatic conditions ;

(*viii*) Markets.

35. *Availability of Pulp and Chemicals.*—Alpha cellulose, whether derived from imported wood pulp or indigenous raw materials, such as cotton, bamboo or bagasse, should be readily available near the rayon factory. A pulping unit manufacturing rayon pulp for a plant producing 5 to 10 tons of rayon will not be an economical proposition. The Panel, therefore, feels that the help and co-operation of the Indian paper mills should be sought to manufacture the special qualities of pulp required by the rayon industry. The possibilities of establishing large sized pulping factories, each producing about 40 to 50 tons of rayon pulp per day were also explored, but it was felt that it may not be advisable to establish large sized pulping factories in India due to lack of availability of raw materials in one area, abnormal railway freights, necessity for dispersal of units etc. The pulp required for rayon should be of the very best quality containing a high percentage of alpha-cellulose and very low percentage of ash. Since it may be economical for a pulping factory to prepare pulps of different grades so as to utilise most of the raw materials available in the vicinity, it would be desirable to set up a pulping factory not only to manufacture pulps of high grade for the rayon industry but pulps of lower grades for other industries such as paper, boards, plastics, etc., which do not require

either high alpha content or can work with pulps of relatively high ash content. In this manner the pulps of various grades made at the factory referred to above could be utilised by the different industries taken as a whole, and it is suggested that in selecting the site upon which the pulping factory is to be established requirements of the other industries such as paper, boards, plastics, explosives, etc., should also be taken into account and should be co-ordinated. Wherever possible these other industries should also be situated either fairly near or within easy reach by sea or rail of the large pulping factory so as to keep the transport charges as low as possible and enable the pulping factory to dispose of its pulps of various grades to the consuming industries in an easy manner. In this connection it should be noted that fairly large quantities of caustic soda and other chemicals would be required by the pulping factories for the chemical treatment of the raw materials such as bamboo, reeds, timbers, etc. If these chemicals are not manufactured near the site of the pulping factory, the question of their transportation at low rates to the pulping factory should be tackled so that the pulps made in India can compete in price with the imported pulps. In addition to these chemicals large quantities of fresh water would be required for washing and cleaning the pulps, but it is assumed that there will be no difficulty in this respect.

36. It has been said before in this report that for the manufacture of 1 ton of rayon, more than 4 tons of chemicals are required. This fact leads to the conclusion that the availability of chemicals near a rayon factory is of no less importance. Sulphuric acid, caustic soda and carbon disulphide are the three basic chemicals used in the manufacture of viscose rayon. From these, carbon-bisulphide will have to be produced on the spot as it is a highly inflammable material and its transportation over large distances, whether by rail or river is not advisable. Sulphuric acid and caustic soda can easily be transported in drums and casks, but in order to keep down the transportation charges, it would distinctly be an advantage if the factories for the manufacture of these two chemicals, which will be required in very large quantities, are situated fairly near the rayon factories. If the caustic soda factory is situated fairly near the rayon factory it will have the additional advantage that it would not be necessary to evaporate the caustic liquor in order to produce sticks for transportation. In this way caustic soda will be available to the factory at a lower cost. From the foregoing analysis it would be clear that the areas which have good possibilities of developing the heavy chemicals industry should receive special consideration in the matter of locating the rayon factories in India.

37. *Abundant Supply of Water.*- Rayon manufacture requires large quantities of soft water. Impurities such as aluminium, calcium and magnesium, which are sometimes present in water, should be carefully removed. Water should also be free from colour, turbidity, excessive bacterial content and other organic impurities. It is estimated that 1 lb. of viscose rayon and 1 lb. of acetate rayon require about 70 and 1,000 gallons of soft water respectively during processing. The water requirements of a 5 ton viscose rayon plant will thus be in the neighbourhood of 3/4 million gallons per day, while the water requirements of a plant of the same size producing acetate rayon will be in the

neighbourhood of 11 million gallons per day. It is therefore essential that constant fresh and abundant supply of soft water is available near a rayon factory.

38. *Power and Fuel.*—The problem of cheap power is of vital importance to this industry since fairly large amounts of power are required for working the rayon plants and the refrigeration units etc. Power required per lb. of rayon is between 3·5 to 4·2 K.W.H. while the steam consumption is stated to be about 70 lbs. per lb. of rayon. The rayon factory should therefore be preferably situated at a place where cheap hydroelectric power is available or can be generated at a low cost from a thermal station, using coal as fuel. In the latter case arrangements should be made for generating steam at a high pressure, so that the bled steam, after working the power plant, may be used in the dyeing and finishing processes. Since a rayon factory works continuously for 365 days in the year and stoppage of work for a number of days is likely to inflict severe loss, arrangements should be made for the supply of energy from a stand by source, if the main supply is cut off at any time. At places where coal is available at cheap rates, it will be economical to put up thermal stations in which turbo generators should be installed for power requirements and the bled steam should be used for processing. Another factor which should be taken into account in selecting suitable sites for the projected rayon factories is the availability of coal at reasonably low prices. It is estimated that about 12 tons of coal (both for steam and power generation) would be required in the production of 1 ton of rayon thus placing the total requirements of a 5 ton per day rayon factory at about 22,000 tons of coal per annum. Since the coal fields in India are localized in certain areas, the transport charges from these areas to distant centres, which from other considerations may be regarded as suitable for rayon factories, may be quite heavy, and it may be more economical for these factories to use fuel oil instead of coal. The Panel therefore, suggests that the Government may consider sympathetically the question of removal of duty on imported fuel oil with a view to helping the establishment of this industry, especially in areas near the ports where the supplies of Indian coal may not be had at competitive prices.

39. *Transport Facilities.*—Transport facilities, particularly in a country like India, where distances are large, are bound to play a decisive role in the future location of industry. In the case of the rayon industry, it assumes added importance because a ten ton daily capacity unit would necessitate movement of approximately 70 tons of materials (excluding coal). It would be more advantageous, if sea or river transport is available, provided other factors are not adversely affected. Transhipment on a large scale should be avoided as far as possible in view of the nature of products to be handled.

Apart from the supply of raw materials, coal, etc., the question of markets for the rayon yarn and staple fibre should be taken into consideration in deciding on the location of the factories while the use of rayon fabrics is spread over the length and breadth of the country, the weaving of rayon yarn into fabrics has made great progress in certain provinces such as Bombay and the Punjab. Similarly, the consumption of staple fibre in admixture with cotton woud be highest where the cotton mills are concentrated as in Bombay, Ahmedabad, etc. These factors should therefore be taken into account so that the incidence of

freight on transporting rayon yarn and staple fibre from the factories to the consuming centres may be as low as possible and the consumers may be able to get their requirements of rayon goods at low prices.

40. *Disposal of Effluent.*—As has already been stated, rayon manufacture requires large quantities of fresh water, which after treatment with chemicals becomes polluted and unsuitable for any other use. It is therefore essential that adequate arrangements should be available for its disposal. It is understood that fairly inexpensive commercial plants (costing about 15,000 £ for a rayon factory of 5 to 10 tons per day capacity) are now available for treating rayon effluents so as to make them practically harmless.

Much of difficulty can be solved internally by an efficient and economic procedure. Recovery of Caustic soda in the Steep Department by Dialysis obviates disposal of large quantities of Caustic. Likewise Acid Regeneration is advantageous for economy reasons, and also in obviating the disposal of large quantities of acidic liquors.

The princip'e of treatment frequently adopted is to blend the acid and alkali liquors in order to neutralise the mixture with the help of an automatic P.H. recorder and then to aerate the liquor in order to reduce its oxygen absorption value and finally to allow the solution to settle down in settling tanks for the removal of sulphur. The neutral liquor thus flows out into a stream, creek or sea. In any case it is necessary that this factor should be carefully thought out when locating a rayon factory and an outlet or other suitable means of disposal should be provided for the contaminated water in such a way that it does not interfere with agricultural areas, irrigation or water supply systems. It should also be noted in this connection that these effluents are fatal to fresh water fish, and therefore they should not be poured out into any streams in which fishing is carried on at present or is likely to be carried on in the near future. In view of the shortage of protein foods for the Indian population, the development of fish industry to provide additional sources of protein is very essential. This development should not be checked by the flow of effluents in rivers and streams which are used as nurseries for fish, and it is suggested that the Provincial and State Governments and their municipal or local bodies should pay special attention to this point when giving licences to rayon factories proposed to be established in the different areas.

41. Keeping in view the above factors the Panel considered a large number of sites for rayon factories. This point was also considered at a joint meeting of the Panel with the representatives of Provinces and States, and the following sites are considered tentatively as being suitable locations for rayon factories in India. It should, however, be mentioned that the Panel had no opportunity of inspecting any of these sites and that proper surveying should be done before a particular site is finally selected.

1. Kalyan, North Kanara and Bhutkal in Bombay.
2. Chanda and Hoshangabad Districts in Central Province & Berar.
3. Kangra District in the Punjab.
4. Banbassa area for acetate factory and Rihand scheme area for viscose factory in the United Provinces.

5. Near Metcur Dam or Nellore District in Madras.
6. Near Calcutta in Bengal.
7. Cuttack District in Orissa.
8. Sind (for acetate factory).
9. Near Krishnarajasagar Dam in Mysore State.
10. Travancore State.
11. Hyderabad State.
12. Rewa State (pulp factory in the first instance).

In addition the possibilities of locating rayon factories in Assam and Indore State should also be investigated.

ORGANISATION OF INDUSTRY.

42. *Sizes of Plants.*—In the U.S.A., Japan and other advanced countries the capacities of rayon plants vary between 2 tons and 20 tons per day, but 5 and 10 ton plants are reported to be quite economical. Considering the conditions prevailing in this country the Panel is of the opinion that plants of 5 and 10 tons per day production capacity would be most suitable. The Panel further considers that in the event of increased demand for rayon goods in the country which might necessitate the setting up of more units, the question might be considered whether it would be a better proposition to establish these units in the different parts of the country or to extend the existing units so as to give increased production. It is not possible to express any definite opinion on this point at this stage, but it is hoped that the experience gained from the working of the first units set up in the country will throw light upon this point. It is, however, suggested that the units which are now proposed to be set up, specially those having a capacity of 5 ton output per day, should, as far as possible, make due allowance for extension at a future date. For this purpose sufficient land should be acquired at the very outset and in making calculations regarding requirements of water, electricity, power, fuel, transport etc., the possibility of enlarging the units to give a higher production should be kept in view.

43. *Foreign co-operation.*—In view of the facts that (*a*) the industry is to be established for the first time in the country (*b*) the processes of manufacture are highly technical and complicated (*c*) the raw materials available in the country have not been properly explored and standardised (*d*) adequate technical advice is not available, foreign co-operation for technical matters in some form or the other would be essential in the initial stages for the industry until it can stand upon its own legs. For the purpose it should be desirable to ask for certain important guarantees from foreign machinery manufacturers regarding production, efficiency and quality of finished product. They should also assist in selecting the best machinery and send their technical experts for erecting the plants and working them in the initial stages. They should, in addition, agree to supply all the technical information available with them and should get investigations carried out in any of the research laboratories abroad with which they may be connected. In any case it is essential, in the opinion of the Panel, that the financial and managerial control of the industry should be with Indians.

44. *Government Aid and Assistance.*—The Panel is of the opinion that if there is likelihood of sufficient private capital forthcoming for the establishment of this industry, it should be allowed to be established and developed on

the basis of private enterprise. This, however, should not debar any Provincial or State Government from subscribing a certain percentage of the capital provided the Government concerned is satisfied as to the soundness of the scheme. If the conditions of the money market change and sufficient private capital is not coming forward to establish the industry, on an adequate scale, and in consonance with Indian requirements, then the Central, Provincial or State Governments should give additional help to the industry by either subscribing larger percentage of the capital, or by giving loans or by guaranteeing a minimum dividend on the capital. In all such cases where the Government either subscribes a certain proportion of the capital or gives other guarantees as indicated above, it should have the liberty to nominate its representatives on the Boards of Directors of the concerns or to appoint special officers to look after their proper working. The nature of the assistance rendered by the Government to the industry and the manner of its representation on the Directorate of the concerns should be decided, from time to time, by a competent authority after reviewing the conditions prevailing at the time and in conformity with the general industrial policy of the Government. In addition to this form of assistance, the Panel strongly urges upon the Provincial and State Governments to assist the promoters of rayon industry in other ways, such as acquisition of land raw material contracts, supply of technical information, cheap power supply water rights, registration of companies, etc.

45. *Protection.*—Regarding protection for the industry, the Panel is of the opinion that the Government should promise to give adequate protection to the industry in the form of protective duties, bounties, subsidy or any other means, the exact method and manner of such assistance to be decided by the Tariff Board. The Panel considers that the Government should take steps from time to time to examine the working of the industry in regard to its efficiency, conditions of employment etc., to ensure that the industry is being run on sound and efficient lines.

In view of the fact, that the Indian rayon industry may use imported sulphite wood pulp in the initial stages, the Panel feels that the import of sulphite wood pulp used specifically for rayon manufacture should be allowed duty free, until the indigenous production is able to meet the requirements of the rayon factories established in India. The drawback duty rebate system is considered suitable for this purpose. The Panel is also of the opinion that import duty on chemicals used in rayon manufacture should be appreciably reduced.

The Panel further recommends that the Government should allow an adequate depreciation on rayon machinery, which wears out quicker on account of its being run continuously throughout the year. The depreciation fixed should be such that the entire capital cost of the plant should be written off in 10 years of working. In this connection it is of interest to note that rayon factories in U.K. and U.S.A. are allowed fairly high rates of depreciation on rayon machinery.

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RESEARCH AND TECHNICAL TRAINING.

46. *Research.*—The rapid development of industries in the Western countries is largely the result of the close co-operation which prevails between science, technology and industry. The Indian industry, on the whole, has not enlisted the aid of science to its help and has not utilised research to improve its processes and finished products. As a result Indian industry has depended largely upon imported machinery and on processes made available by foreign manufacturers. The Panel feels that this is not a healthy state of affairs and should be brought to an end by the development of industrial research aimed at helping the existing industries and fostering new ones.

47. *Co-operative Research.*—In foreign countries, large sums of money are spent by the industry and the Government on research every year. More than 28 co-operative research institutes, besides the Government and university laboratories, are functioning in England. Facilities for industrial research are still more numerous in the United States of America. The larger factories have their own departments of research besides contributing large sums of money for co-operative laboratories. The result has been that the growth of industry in these countries has been phenomenal and the quality of goods has steadily improved while costs of manufacture have been brought down, thereby enabling them to capture foreign markets.

48.—It has been repeatedly emphasised before that (*a*) rayon manufacture is a very technical and complicated process (*b*) the utilisation and exploitation of the Indian raw materials have not been systematically studied (*c*) the costs of manufacture under Indian conditions have not been worked out and (*d*) no technical experts for rayon manufacture are available in the country. In order to overcome all these difficulties, the Panel considers that extensive research work should be initiated on various problems of the rayon industry. Research assumes special significance for the development of this industry, because the Indian rayon industry is bound to experience keen competition from the foreign manufacturers especially U. S. A. and U. K. in the post-war period. The Panel therefore strongly recommends that large sum of money should be spent on rayon research. In this connection the Panel feels that expenditure on research should be shared both by the industry and the Government and that research should be on co-operative lines.

49. *Central Cellulose Research Centres.*—In order to foster rayon research in right earnest this Panel strongly recommends that the Government of India should establish two Cellulose Research Centres on the lines of the co-operative research laboratories established in England for such industries as glass, textiles, woollens, leather etc., at a very early date. The proposed Centres should undertake all problems connected with industries which use

cellulose, in one form or the other and for which adequate research facilities are not available at present in the country. One of these Centres should concentrate on problems relating to the manufacture of pulps of different kinds by chemical and mechanical processes, while the other Centres should study research problems relating to the utilisation of these pulps in the various consuming industries such as rayon, plastics, explosives etc. It is advantageous to split the research work at two Centres as the problems relating to the preparation of pulp from raw materials like bamboo, linters, woods, grasses, etc. constitute a distinct set from the problems relating to the utilisation of these pulps. This division of research work has been carried out in the U. S. A. where a number of institutes are carrying on work only on the preparation of chemical and mechanical pulps without studying the problems relating to their utilisation which are investigated in separate institutes. From the geographical point of view also this proposal has an advantage in so far as the raw material producing areas from which pulps can and will be made are not generally situated near those areas which, from other considerations, may be regarded as suitable for the establishment of rayon factories. It is always an advantage to have a research institute fairly near to the consuming or utilisation centres so that a direct contact is maintained between the research workers and those who are interested in the industrial development of the materials. It is recommended that these two Centres should work in close collaboration with one and other and avoid duplication as far as possible.

50. The schemes for these two Centres should be prepared by an expert committee or committees. Regarding location of the first Centre, the Panel feels that Dehra Dun, where a separate section already exists at the Forest Research Institute for paper and pulp research, would be an ideal site. At this Centre researches on the preparation of pulps of different types and qualities would be carried out. Since Dehra Dun Forest Research Institute already possesses the Paper and pulp Section, further work on the utilisation of pulps for the manufacture of these articles may also be located in this centre. However, as regards the utilisation of pulps for other purposes such as rayon, plastics, explosives etc., it would be an advantage to locate this Centre some where near Bombay as it will be more central to the various industries consuming pulp, which are likely to spring up in the future. Furthermore, a good deal of work is now being done on the finishing problems of textiles and since some of the problems relating to spinning, weaving, dyeing, finishing etc., are common to cotton and rayon, it would be an advantage to have the second institute near a large textile centre such as Bombay where the inter-action of the two industries and the study of the problems common to them may be carried out profitably. In addition, specific problems of research may be given to universities or other centres where facilities for such research are available.

51. *Immediate Problems of Research.*—For solving the immediate problems of the rayon industry the Panel makes the following recommendations :—

(*i*) The Government of India should take immediate steps to instal a pilot plant (having a capacity of 100 lbs. per batch) for the production and processing of rayon yarn. This pilot plant should be complete in every

respect, beginning with the preparation of pulp from Indian raw materials including linters and having sections for spinning, weaving, dyeing, finishing of the yarn and fabrics. It should be located in a suitable building near a textile centre, preferably in Bombay, and should be capable of dealing with the problems of viscose as well as acetate rayon. In view of the fact that samples of pulp prepared at the Dehra Dun Centre will be ready in the near future, the Government should instal this pilot plant as early as possible so that these samples may be tested as regards their suitabilty in the manufacture of rayon. It would be advantageous if the two Centres start functioning at about the same time.

(*ii*) The Government of India should immediately sanction the installation of a pilot plant for the preparation of chemical wood pulp by the sulphite process. In this connection, it is understood that the Paper and Pulp Research Section at the Forest Research Institute, Dehra Dun, already possesses a pilot plant for the preparation of pulp by the sulphate process and arrangements are being made to import a pilot plant for the sulphite process. The Panel is therefore of the opinion that research work on the preparation of pulp both by sulphite and sulphate process should be carried out at Dehra Dun under adequate supervision. When the semi-commercial pliot plant recommended by the Panel, is set up, the indigenous pulps prepared at Dehra Dun should be tried out on this plant.

(*iii*) The Government of India should take steps to constitute a technical committee containing among others, representatives of the Board of Scientific and Industrial Research, the Indian Central Cotton Committee, the Central Sugar Cane Committee and the Forest Research Institute to sponsor cellulose research in India.

52. *Technical Training.*-There is no denying the fact that there is at present an acute dearth of technical personnel in India. It is more so in the case of the rayon industry, where not a single Indian can claim to be an expert. When plans for the establishment of this industry are afoot, it is essential that due attention should be paid to the training of technical personnel.

The Panel strongly feels that the Government of India should send for the next few years 12 young Indians (6 chemists and 6 engineers) abroad every year for specialised trainining in rayon manufacture. They should be selected on Provincial and State basis. These trainees should preferably be trained in factories manufacturing rayon. Besides this the foreign manufacturers supplying rayon plants in India should undertake to train a few Indian personnel at their works, which should be made a condition of purchase of machinery from them.

The Panel feels that foreign technical experts should be invited to India to train Indian personnel. This could be easily arranged with the machinery manufacturers.

The proposed Cellulose Research Centres when established should have a section for the training of technicians in the spheres of work assigned to them. These technicians should be admitted as apprentices in rayon factories, and should subsequently be employed on reasonable terms.

SUMMARY OF RECOMMENDATIONS.

The Panel is of the opinion that India is very favourably placed for the establishment of the rayon industry.

2. The pre-war consumption of rayon in India was between 60 to 70 tons per day. In order to cover the pre-war demand by indigenous production, the Panel is of the opinion that there is easily room for 6 to 7 rayon factories (each having a daily production capacity of 10 tons) in India in the immediate post-war period with a possible addition of another 4 to 5 factories as the requirements increase owing to an increase in population and rise in the standard of living.

3. Units of 5 and 10 tons production capacity per day are considered most suitable for this country, in view of the need of developing the different regions and spreading out factories over a wide area.

4. Six out of these seven factories should be for the manufacture of viscose rayon (yarn and staple fibre). In view of the modern trend of increased use of union fabrics, at least one factory should be for the manufacture of acetate rayon.

5. The Panel feels that India is very favourably placed with regard to cellulose which is the basic raw material for rayon manufacture, although extensive research work has to be carried out to work out the technical details, to estimate the cost of manufacture of the pulp and to standardise the quality of pulp produced from indigenous raw materials. Under these circumstances the Panel recommends that rayon manufacture may, in the initial stages, be started by using imported wood pulp. The Panel however strongly feels that the use of indigenous raw materials should be encouraged and developed simultaneously with the establishment of the rayon industry so that India may not remain dependent upon foreign suppliers for an essential raw material.

6. As no reliable statistical data on the availability of cellulose raw materials is available, the Panel recommends that the Government should arrange for the carrying out of an immediate survey of all cellulosic raw materials including soft and hard wood, bamboo, grass, other reeds, cotton linters, cotton wastes etc., available in the country.

7. The Panel recommends that the Government should take steps to establish a semi-commercial plant of a capacity of about 100 lbs. per day for preparing the pulp and about 100 lbs. per day for spinning the yarn, complete in every respect.

8. In view of the large quantities of chemicals needed in the manufacture of rayon, the Panel feels that there should be close co-ordination in the execution of the plans and recommendations of this Panel with those of the Heavy Chemicals Panel.

9. Regarding purchase of rayon machinery, the Panel is of the opinion that the Indian industrialists intending to purchase rayon machinery from abroad should make a thorough investigation, with the help of technical experts, of the type, efficiency and productive capacity of the plants for which the quotations are submitted to them. The present restrictions on exchange should be relaxed at as early a date as possible in order that quotations may be obtained in a free and competitive market and the choice of the Indian buyers may not be restricted to certain types of machinery.

10. Machinery and plants worth about Rs. 15 crores will be required for the proposed seven units each of 10 ton daily production capacity. The cost of buildings, erection etc., will be extra.

11. The Panel feels that good use can be made in the country of Japanese rayon machinery, which may fall to India's lot by way of reparations.

12. The Panel considered a large number of sites for rayon factories. This point was also considered at a joint meeting of the Panel with the representatives of Provinces and States, and the following sites are considered tentatively as being suitable locations for rayon factories in India. It should, however, be mentioned that the Panel had no opportunity of inspecting any of these sites and that proper surveying should be done before a particular site is finally selected :—

1. Kalyan, North Kanara, and Bhutkal in Bombay.
2. Chanda and Hoshangabad Districts in Central Provinces and Berar.
3. Kangra District in the Punjab.
4. Banbassa area for acetate factory and Rihand Scheme area for viscose factory in the United Provinces.
5. Near Mettur Dam or Nellore District in Madras.
6. Near Calcutta in Bengal.
7. Cuttack District in Orissa.
8. Sind (for acetate factory).
9. Near Krishnarajasagar Dam in Mysore State.
10. Travancore State.
11. Hyderabad State.
12. Rewa State. (pulp factory in the first instance).

13. The Panel recommends that the Government should promise to give adequate protection to the industry in the forms of potective duties, bounties subsidy, or any other means, the exact method and manner of such assistance to be decided by the Tariff Board.

14. The Panel recommends that in the initial stages, until normal conditions return and prices quoted by foreign machinery manufacturers are brought down to reasonable levels, the rayon industry should be relieved of the import duty on machinery.

15. In view of the fact that the Indian Rayon Industry may use imported sulphite wood pulp in the initial stages, the Panel feels that the import of sulphite wood pulp used specifically for rayon manufacture should be allowed duty free. The draw back duty rebate system is considered suitable for this purpose.

16. The Panel recommends that two research centres for cellulose research should be established by the Government.

17. The Panel recommends that the Government of India should send 12 young Indians (6 chemists and 6 engineers) abroad every year for specialised training in rayon manufacture. These trainees should preferably be trained in factories manufacturing rayon.

Nazir Ahmad . . . Chairman.

Shantidas Askuran
Gautam Sarabhai
M. P. Bhargava
P. N. Sinha
M. Subba Rao
Rasiklal J. Chinai
. . . Members.

A. S. Bhatnagar . . . Secretary.

APPENDIX I.

Production of continuous filament rayon in World and in selected countries 1911—1942.†

Year.	United States.	Japan.	Germany	Italy.	Great Britain.	France	Other	World total.	Percentage change from preceding year.
	Million pounds	Million pounds	Million pounds	Million pounds	Million pounds	Million pounds	Million pounds	Million pounds	Million Pounds.
1911	·4	..	*	*	*	2·6	15·7	18·7	..
1912	1·1	..	*	*	*	2·9	15·8	19·8	5·9
1913	1·8	..	7·7	·3	6·6	3·3	5·5	25·2	27·3
1914	2·4	..	3·5	*	4·0	2·0	7·8	19·7	—21·8
1915	3·9	..	2·2	*	4·0	·9	7·5	18·5	—6·1
1916	5·8	..	5·5	*	3·5	1·6	7·0	23·4	26·5
1917	6·5	..	6·6	*	3·8	1·2	6·1	24·2	3·4
1918	5·8	·1	8·8	·4	3·0	1·4	6·4	25·9	7·0
1919	8·3	·1	7·7	·7	4·8	1·8	4·4	27·8	7·3
1920	10·1	·2	5·2	1·6	6·0	3·4	6·6	33·1	19·1
1921	15·0	·2	7·7	3·2	9·0	4·4	8·7	48·2	45·6
1922	24·1	·5	11·0	6·6	14·5	6·8	13·1	76·6	58·9
1923	35·0	·8	14·3	11·0	17·0	7·7	17·2	103·0	34·5
1924	36·3	1·4	23·2	17·6	24·7	13·2	21·9	138·3	34·3
1925	51·0	3·2	26·0	30·8	29·8	14·3	30·2	185·3	34·0
1926	62·7	5·0	21·7	36·8	25·5	19·2	37·8	211·7	14·2
1927	75·6	10·5	41·3	53·8	38·8	24·2	50·9	295·1	39·4
1928	97·2	16·6	48·9	57·3	52·1	29·9	58·5	360·5	22·2

† Taken from the pamphlet "Survey of development and use of rayon and other synthetic fibres" issued by the Department of Agriculture, U. S. A.

*Separate data not available. Production if any included under "other"

APPEDIX I—*contd.*

Production of continuous filament rayon in World and in selected countries 1911—42.

Year.	United State	Japan.	Germany	Italy.	Great. Britain.	France.	Other	Wor' d total	Percentage change from proceeding year.
	Million pounds	million pounds	Million pounds.	Million pounds.	Million pounds.	Million pounds.	Million pounds.	Million pounds.	Million pounds.
1929	121·4	26·0	58·4	71·3	52·7	41·8	62·6	434·2	20·4
1930	127·3	36·6	59·0	66·3	47·0	50·6	64·4	451·2	3·9
1931	150·9	48·3	61·3	74·2	52·7	44·0	67·7	499·7	10·7
1932	134·7	69·8	58·0	62·3	69·9	50·6	72·0	517·3	3·5
1933	213·5	98·3	62·9	73·4	80·0	57·0	78·3	663·4	28·2
1934	208·3	153·1	84·9	85·8	88·9	57·2	94·3	772·5	16·4
1935	257·6	224·3	97·7	85·7	112·2	61·5	102·1	941·1	21·8
1936	277·6	275·0	99·0	86·0	116·8	59·5	109·4	1,023·1	8·7
1937	321·7	334·3	125·0	106·0	119·7	66·4	126·3	1,200·0	17·3
*1938	257·6	209·6	140·0†	101·4	106·4	61·8	111·3†	988·3	—8·2
*1939	328·6	239·4	160·0†	119·0	120·0	56·2	122·31†	1,145·5	11·6
1940	390·1	225·0	250·0‡	100·0	100·0	†	78·96†	1,144·0	0·1
1941§	451·2	..	..	..	..	..	..	1,300·0	13·6
1942§	479·3	300·0	220·0†	132·0	90·0	69·5	156·4	1,447·2	11 3
1943	501·1	..	..	..	..	..	..	..	..

† Figures for Germany include production of Austria, 1938-42, Czechoslovakia, 1939-42 ; Poland 1940 1942 & Belgium, France, Hungary, Netherland , Norways Rumania, 1940.

§ Data for 1941 and 1942 for foreign countries are, estimates. Data for European countries for 1942 are from Bureau of Foreign and Domestic Commerce.

APPENDIX II.

Production of rayon staple fibre in World and in selected countries, 1929-1942.

Year.	United States.	Japan.	Germany	Italy.	Great Britain.	France.	Other	World Total.
	Million Pounds	Million Pounds	Million Pounds	Million Pounds	Million Pounds	Million Pounds	Million Pounds	Million Pounds
1929	·5	..	2·4	1·7	2·6	..	..	7·2
1930	·3	..	4·4	·7	·8	..	..	6·2
1931	·9	..	4·4	1·4	·8	·5	..	8·0
1932	1·1	·6	3·0	9·4	1·2	1·6	·4	17·3
1933	2·1	1·0	8·8	11·0	2·4	2·2	·4	27·9
1934	2·2	4·7	15·8	21·6	2·4	4·4	·7	51·8
1935	4·6	13·6	37·9	67·7	9·3	5·0	1·5	139·6
1936	12·3	45·8	94·8	110·1	26·2	6·6	2·8	298·6
1937	20·2	174·2	219·2	156·3	32·7	11·3	5·3	619·2
1938	29·9	375·0	330·0	166·9	31·7	10·8	13·3	957·6
1939	51·3	309·9	440·0*	190·0	60·0	15·5	14·7*	1082·0
1940	81·1	300·0	575·0*	225·0	50·0	*	55·7*	1236·8
1941†	122·0	..	..	..	..	..	..	1480·0
1942†	153·3	400·0	880·0*	330·0	45·0	128·0	89·4*	2025·7
1943	162·0	..	..	..	..	..	..	..

*Figures for Germany include production of Czechoslovakia, 1939-42; Poland, 1940, 1941 Belgium France, Rumania, 1940.

†. Data for 1941 and 1942 for foreign countries are estimates. Data for European countries for 1942 are from Bureau of Foreign and Domestic Commerce. Data for 1942 for Germany, Italy and France include casein fiebr.

APPEN

Quantity and value of imports o

	1935-36.		1936-37.		1937-38.	
	Quantity in lbs.	Value in Rs.	Quantity in lbs.	Value in Rs.	Quantity in lbs.	Value in Rs.
Artificial Silk Yarn	14,911	8,363	17,629	9,939	31,589	20,535
Artificial silk yarn mixed with other textile or staple fibre excluding silk	..	..	..	..	..	..
Manufacture.—Hosiery, Socks & Stocking made entirely of Artificial silk	222 Yds.	424	160 Yds.	306	415 Yds.	813
Piecegoods made entirely of Artificial Silk	74,491	18,848	1,02,319	23,826	89,695	21,813
Goods of Artificial Silk mixed with other materials containing 50 % or more of cotton	7,377	2,281	10,918	2,714	14,561	3,339
Containing no cotton or less than 50% cotton	880	1,122	969	1,042	1,518	1,539
Blankets wholly or mainly of Artificial Silk	..	..	..	..	..	..
Other Sorts	..	540	..	732	..	710
Total Artificial Silk ..	..	31,578	..	38,559	..	48,749
Staple fibre & Yarn Raw (cut fibre and waste)	..	..	..	..	191	87
Yarn :—Made of Staple fibre only	..	..	..	..	2,422	1,924
Made of Staple fibre mixed with other textile fabrics	..	..	..	..	69	127
Total of Yarn ..	..	..	..	..	..	..
Total of Staple Fibre & Yarn ..	..	..	..	..	..	..
Fabrics containing gold or silver-threads	..	67	..	16	..	4

DIX III

artificial silk in India 1935-36 to 1942-43.

1938-39		1939-40		1940-41		1941-42		1942-43	
Quantity in lbs.	Value in Rs.	Quantity in lbs.	Value in Rs.	Quantity in lbs.	Value in Rs.	Quantity in lbs.	Value in Rs.	Quantity in lbs.	Value in Rs.
17,248	9,588	30,764	21,205	33,889	26,482	13,719	15,521	201	328
169	166	418	387	233	219	66	64	..	..
202	327	114	210	58	189	64	263	5	33
Yds.		Yds.		Yds.		Yds.		Yds.	
28,593	9,828	54,320	21,066	53,456	24,471	27,729	16,804	1,124	1,536
3,810	1,125	5,053	1,641	3,463	1,387	1,920	901	53	78
1,239	1,066	1,634	1,161	1,358	1,403	916	1,051	143	276
55	60	33	48	9	14	6	14	..	1
..	201	..	144	..	271	..	279	..	58
..	22,361	..	45,862	..	54,456	..	34,897	..	2,305
340	158	509	255	52	49	527	848	1	2
2,255	2,008	6,820	5,408	9,876	8,295	4,809	6,354	20	25
4	4	10	10	11	10	..	..	..	..
..	..	..	..	9,887	8,305	4,809	6,354	20	25
..	..	..	..	9,939	8,354	5,336	7,202	21	27
..	97	..	..	..	2	..	3	..	

N.B.—Value is given in thousands of Rupees. Quantity is given in thousands of lbs. or thousands of Yards.

APPENDIX IIIA

Quantity and value of imports of artificial silk in India from Japan 1935-36 to 1941-42.

	1935-36.		1936-37.		1937-38		1938-39		1939-40		1940-41		1941-1942	
	Quantity in lbs.	Value in Rs.	Quantity in lbs.	Value in Rs.	Quantity in lbs.	Value in Rs.	Quantity in lbs.	Value in Rs.	Quantity in lbs.	Value in Rs.	Quantity in lbs.	Value in Rs.	Quantity in lbs.	Value in Rs.
Artificial Silk Yarn	9,956	5,306	15,129	8,438	28,238	8,193	6,509	4,127	21,876	15,663	32,490	25,395	12,724	14,762
Artificial silk yarn mixed with other textile or staple fibre excluding silk	..	..	..	..	..	..	157	133	405	351	233	219	66	64
Manufacture														
Hosiery Socks and Stockings made entirely of artificial silk ..	205 *Yards*	327	146 *Yards*	229	383 *Yards*	659	188 *Yards*	259	103 *Yards*	154	33 *Yards*	77	27 *Yards*	62
Piecegoods made entirely of artificial silk	73,732	18,432	101,446	23,276	88,455	20,968	26,291	8,707	51,615	19,545	51,371	22,733	24,779	13,463
Goods of artificial silk mixed with other materials containing 50% or more cotton	5,120	1,310	10,110	2,121	13,971	2,886	3,450	823	4,653	1,321	3,151	1,091	1,666	654
Containing no cotton or less than 50% cotton	617	721	644	656	1,024	837	823	548	1,219	719	877	850	376	330
Blankets wholly or mainly of artificial silk	..	..	..	..	..	..	43	46	33	48	7	11	6	10
Other sorts	..	300	..	586	..	583	..	61	..	79	..	200	..	185
Total Artificial Silk ..	..	26,396	..	35,306	..	44,127	..	14,804	..	37,890	..	50,576	..	29,530
Staple Fibre and Yarn—Raw (cut fibre and waste)	..	..	..	..	179	80	31	14	455	212	16	8	435	783
Yarn : made of staple fibre only ..	..	..	..	..	2,416	1,920	2,117	1,912	6,793	5,375	1,695	8,161	4,809	6,353
Yarn : made of staple fibre mixed with other textile fabrics	..	..	..	..	69	127	4	4	9	9	11	10	..	..
Total of Yarn ..	..	..	..	..	2,485	2,047	2,121	1,916	6,802	5,384	9,706	8,171	4,809	6,353
Total of staple fibre and yarn ..	..	..	..	..	2,664	2,127	2,152	1,930	7,257	5,596	9,722	8,178	5,244	7,136
Fabrics containing gold and silver threads	..	1	..	1	..	..	..	59	..	..	..	..	..	..

N. B.—Value is given in thousands of Rupees
Quantity is given in thousands of lbs. or yards.

APPENDIX IV

Rayon Weaving Mills.

No.	Looms.	Name.
1	157	Abdul Karim Mills, Bombay.
2	269	Ahmed Silk Mills, Bombay.
3	54	Alliance Silk Mills, Bombay.
4	92	Bajaj Textile Mills, Bombay.
5	138	Bharat Silk Mills Ltd., Bombay.
6	300	Bipin Silk Mills Ltd., Bombay.
7	29	Bombay Silk Mills, Bombay-5.
8	202	Dhanamall Silk Mills, Surat.
9	56	Garden Silk Weaving Factory, Surat.
10	31	Indianese Silk Mills Co., Bombay.
11	107	Jasmine Mills Ltd., Bombay.
12	68	Khetani Textile Industries Ltd., Bombay.
13	18	Kothari Silk Mills, Bombay.
14	96	Mahalaxami Mills Ltd., Bhavangar, (Kathiawar).
15	207	Maharana Mills Ltd., Porbunder, (Kathiawar).
16	160	Mahendra Silk Mills Ltd., Ahmedabad.
17	293	Manbar Mills Ltd., Bombay.
18	120	Master Silk Mills, Kathiawar.
19	28	Mohanlal Silk Mills, Bombay.
20	36	Narendra Silk Mills, Bombay.
21	202	Nanikram Sobhraj Mills Ltd., Ahmedabad.
22	100	National Art Silk Mills Ltd., Bombay.
23	57	New Era Textile Mills Ltd., Bombay.
24	152	New India Rayon Mills Co., Ltd., Bombay.
25	76	New Laxminarayan Silk Mills, Ahmedabad.
26	66	New Mahalaxmi Silk Mills, Ltd., Bombay.
27	110	Panalal Silk Mills, Bombay.
28	72	Prabhat Silk & Cotton Mills Ltd., Surat.
29	100	Ramlal Silk Mills, Bombay.
30	50	Rohit Mills Ltd., Ahmedabad.
31	50	Secunder Sari & Silk Mills, Bhiwandi, (Dist. Thana).
32	64	Sharda Silk Mills Ltd., Bombay.
33	108	Shree Laxami Silk Mills, Bombay.
34	300	Shree Shakti Mills Ltd., Bombay.
35	20	Shree Shanti Silk Mills, Bombay.
36	112	Surat Silk Goods Mills, Surat.
37	32	Venus Silk Mills, Bombay.
38	90	Vinod Silk Mills, Bombay.
Total	4,209 looms.	

Silk and art silk mills in the Punjab (suitable for weaving Rayon goods).

No.	Looms	Name.
1	157	Amritsar Rayon & Silk Mills, Amritsar.
2	63	Mehra Textile Mills, Amritsar.
3	83	Khanna Silk Mills, Amritsar.
		(Partially suitable for weaving rayon goods).
4	57	Indian Woollen and Silk Mills, Amritsar.
5	24	Kapur Silk Weaving Mills, Amritsar.
6	20	Krishan Textile Mills, Amritsar.
7	53	Hindustan Embroidery Mills, Amritsar.
8	12	New India Embroidery Mills, Amritsar.

APPENDIX V

*Per capita consumption of cotton & Rayon in 1937.**

in lbs.

	Country.	Cotton.	Rayon.
1	U. S. A.	23·1	2·88
2	United Kingdom	17·8	2·51
3	India	3·5†	0·10

Consumption of rayon increased to 4·32 lbs. per head in U. S. A. in 1941.

APPENDIX VI

‡ *Consumption of rayon and fibre per head.*

	lbs.
Germany	6·49
Japan	5·30
Italy	3·82
Australia	3·08
United States	2·83
United Kingdom	2·44
New Zealand	2·43
Switzerland	1·97
Sweden	1·91
Canada	1·76
Czecho-Slovakia	1·73
Netherlands	1·36
Belgium	1·50
France	1·24
Denmark	1·14
Trinidad	1·04
Eire	0·80

*Silk and Rayon August 44.

†In 1935.

‡From Silk and Rayon—March 1944.

APPENDIX VII

APPENDIX

Particulars regarding

Serial No.	Variety of seed.	Place where delinted.	Gin Saw or roller.	First Cut, Second cut or Mill.	Price per md. of 822 lb.
1	4F	Khanewal ..	Saw	First Cut	Rs. 5 to 6 locally and loose.
2	4F	Mailsi	,,	,,	Rs. 5/8/- ,,
3A	4F	Vihari	,,	,,	,, ,, ,,
3B	289F	,, ..	,,	,,	Rs. 6/- ,, ,,
4	20% Desi 80% P.A.	Okara	,,	..	..
5	50% Desi 50% P.A.	,, ...	,,	..	..
6	285 F	Hyderabad Sind ..	Saw & Roller.	First Cut	Rs. 5/- f. o. r.
7	285 F	,, ,, ..	Mixed	,,	..
8	285 F	Navasari ..	,,	Mill run.	..
9	4 F	Burewala ..	Saw ..	First Cut	Rs. 6/- to Rs. 8/-
10	289 F	Sargodha ..	,,	,,	Rs. 5/10/-
11	30% Desi 70% P.A.	Okara	,,	,,	..
12	289 F	Mianchannu ..	,,	,,	..
13	4 F	Arafwala ..	,,	,,	..
14	4 F	Montgomery ..	,,	..	Rs. 8/- f. o. r.
15	75% 289F 25% 4F	Mianchannu ..	,,	..	..
16	289 F	Khanewal ..	,,	First Cut	Rs. 7/4 including pressing charges.
17	85% 4F 15% Desi	Lyallpur ..	,,	,,	Rs. 8/-
18	4 F	Mianchannu ..	,,	,,	Rs. 7/-
19	4 F	Khanewal ..	,,	,,	..
20	289 F	Sargodha ..	,,	,,	Rs. 4/8/-
21	289 F	Mianchannu ..	,,	,,	1st & 2nd quality linters at Rs. 6/-.
22	4 F	,, ..	,,	,,	,, ,,
23	289 F	,, ..	Roller	,,	3rd quality at Rs. 2

VII

Indian linters of 1939-40.

Delinting machine used.	Linters recovered per ton of seed.	Matching U.S.A. Grade No.		Colour.	Foreign matter.
		Character	Colour.		
Continental	45 lb. to 67 lb.	3	..	Greyish white..	Small brown and peppery leaf some stalk, also some bollrests.
Carvers	,,	2—3	..	,,	Some brown & peppery leaf few stalks & some undeveloped green seed.
,,	,,	4	..	Greyish	Small amount of leaf and stalk but fair amount of undeveloped seed ; and some boll-husks.
,,	,,	I 3 II 1	3 1	I II	Small amount of leaf and a few seeds. Large amount of seed, some black ones (Egyptian)
,,	45 lb.	2	..	Greyish white	Small quantity of seed & some whole seed.
,,	,,	3	..	,,	Fair quantity of small leaf also small quantityof seed.
,,	,,	3	..	Dirty Yellow	Fair quantity of brown leaf, some cotton fibres distributed throuhout the sample.
,,	,,	3	..	Very dirty yellow.	Large quantity of leaf and some crushed seed
,,	45 lb. to 56 lb.	6—7	..	Dirty brown	..
Continental	18-17 lb.	2	..	Greyish white	Fair amount of leaf, also some whole & crushed seed—some boil rest also.
,,	60 lb.	3	3	..	Some leaf & some whole & crushed seed.
Varner	40 lb.	2	..	Greyish white	Slight leaf & a fair quantity of seed.
Continental	55 lb.	1	..	Whiter than U.S. Grade No. 1.	Small leaf & a small quantity of undeveloped seed.
,,	25-28 lb.	2	..	Whiter than U.S. Grade No. 2.	Slight leaf & a large quantity of whole seed, some of them in clusters.
,,	13 lb.	2	..	Greyish white	Large quantity of peppery leaf and some crushd seed
,,	54 lb.	1—2	1—2	,,	Some leaf & a fair large qauntity of crusheed seed
,,	27 lb.	2—3	2—3	..	Black peppery leaf & slight crushed seed.
,,	About 10 lb.	3	..	Greyish white	Fairly large amount of leaf & some crushed seed.
,,	41 lb.	1	..	Whiter than US Grade No. 1.	Fair amount of leaf & some undeveloped seed.
,,	17 lb.	2	..	Greyish white	Some leaf & slight sand.
Carvers	54 lb.	2	..	Whiter than US Grade No. 2.	Small quantity of seed & some whole seed.
Country (self made) delinting machine.	42 lb.	1	1	..	Small quantity of leaf as well as whole & crushed seed.
,,	22 lb.	2	..	Whiter than US Grade No. 2.	Small quantity of leaf and very small quantity of whole and crushed seed.
,,	36 lb.	3	..	Whiter than U.S. Grade No. 3.	Plenty of leaf, stalk and seed.

APPENDIX VIII.

Distribution of domestic continuous filament rayon shipments by trades.

**United States of America.*

1930—1943.

Year	Knit Goods.			Woven goods.			Miscellaneous.[6]	Total shipments.
	Hosiery[2]	Other knit[3].	Total	Broad Woven and Tires[4]	Narrow Woven[5]	Total Woven		
	Million pounds	Million pounds	Million pounds	Million pounds	Million pounds	Million pounds	Million pounds	Million pounds
1930	16·5	38·0	54·5	49·5	3·0	52·5	4·6	111·6
1931	21·1	48·7	69·8	75·6	4·0	79·6	6·2	155·6
1932	19·0	38·0	57·0	84·6	3·9	88·5	6·3	151·8
1933	17·0	41·3	58·3	141·3	5·5	146·8	5·9	211·0
1934	14·1	39·9	54·0	131·3	4·8	136·1	4·6	194·7
1935	14·7	47·9	62·6	179·5	5·2	184·7	5·4	252·7
1936	16·3	51·0	67·3	217·0	8·2	225·2	4·9	297·4
1937	12·6	38·9	51·5	202·5	7·4	209·9	4·8	266·2
1938	14·1	39·6	53·7	209·3	6·7	216·0	4·1	273·8
1939	16·2	49·9	66·1	278·6	9·1	287·7	5·8	369·6
1940	16·4	54·0	70·4	304·4	8·2	312·6	5·7	388·7
1941	26·3	57·9	84·2	349·2	10·2	359·4	8·8	452·4
1942	49·3	56·3	105·6	343·6	8·7	352·3	10·9	468·8
1943	49·2	56·1	106·3	360·4	10·4	370·8	18·1	494·2

* Taken from the pamphlet "Survey of development and use of rayon and other synethetic fibres." issued by the Department of Agriculture, U. S. A.

2. "Hosiery" includes all manufacturers of seamless and full-fashioned hosiery.

3. "Other knit" includes all manufacturers of circular and flat-knit underwear plus other knit goods such as outerwear, sweaters, and knitted dress goods.

4. "Broad wovens" includes all broad-loom weavers whether they be "silk weavers", "cotton weavers," "woollen and worsted weavers" or rayon weavers

5. "Narrow woven" includes manufacturers of such items as ribbons, tapes, and woven elastic goods, which are of a width narrower than 81 inches.

6. "Miscellaneous" includes all other outlets such as bag, lace and braid manufacturers.

APPENDIX IX

Brief Description of the Viscose and Acetate Processes.

Viscose Process

Briefly the Viscose process consits of the following operational stages.

Viscose Rayon Manufacture starts with wood pulp of 88% to 92% Alpha-Cellulose content. The raw material is carefully conditioned to standard moisture content and then placed in a steep tank containing dilute caustic soda solution of approximately 17·5% NaOH and thus becomes Alkali-Cellulose.

This Alkali-Cellulose is then shredded or milled into a light flocculent mass reminiscent of " bread crumbs ". The crumbs are then aged and allowed to stand for a specified period of time in a carefully regulated temperature.

Churning is the next operation wherein the Alkali-Cellulose crumbs are allowed to react with carbon bisulphide gas and during the course of which the hole product is slowly rotated in a large cylindrical vessel. The product thus formed is Cellulose Xanthate and is now passed on for dissolving in Caustic Soda. Large mixers are employed in this operation and an intimate dispersal of cellulose in Caustic is produced, the resultant liquor being styled " Viscose ". Filtration and ripening then follow wherein the viscose is progressed through large tanks during a specified period of time and at a carefully controlled temperature. Vaccum is applied to the contents before the liquor is finally conveyed to the spinning operation.

In this operation of spinning, the liquor is extruded through very fine jets or spinnerettes into a bath containing acid and mineral salts which decompose the liquor, regenerate the cellulose and the coagulated thread thus produced is taken up over glass rollers and deposited into a box rotating at a high speed which collects the thread in the form of a compact textile package. The yarn is than washed, desulphurised, bleached, softened and finally dried and conditioned to the requisite moisture content. The Rayon Yarn is now a saleable commodity which may be processed to any desired textile form.

Acetate Process.

In the Viscose process briefly described, Cellulose was the basic raw material and the resultant fibre was almost pure cellulose. The problem of manufacture being to render cellulose soluable and to prepare viscose mixture from it with the properties of coagulation after extrusion and in so doing to regenerate the cellulose. In the acetate process, although cellulose is once more the raw material, an acetyl ester of the same is prepared, and is the resulting constitutent of the fibre.

Cotton linters or wood pulp are again the source of raw material, the purity and quality being vital to the success of the process.

The raw material is treated with acetic anhydride, glacial acetic acid and a catalyst to form a cellulose acetate which dissolves in the solution. By pouring this fluid into water, it is reprecipitated as a white flocculent mass. This mass is thoroughly washed, dried and then dissolved in acetone to form the spinning liquor.

The process is delicate in so far as strict temperature, time and quantity control must be observed to guarantee a product with constant properties.

In spinning, the usual procedure of extrusion through fine jets is adopted. The solution is forced through the jet in a downward vertical direction, the jets being enclosed in tubes into which a current of warm air is inducted, by contact with which the issuing filaments are set by evaporation of the acetone. At the bottom of the tube the filaments are collected and wound on to a bobbin, twist being imparted, to the thread in a subsequent twisting operation.

Unlike, Viscose the yarn is now in a saleable condition and no further operations are necessary to bring out the lustre and purity of thread. In fact, the distinctive properties of acetate yarn are due to the acetic ester content, and should any large proportion be removed, loss of lustre and shrinkage will result. Furthermore, in other processes, the weight of yarn produced in somewhat less than the weight of the original raw material, whereas in acetate there is an increase amounting to 60% on the weight of the raw material. The appreciation in weight is of course due to the substitution of an acetyl group, weighing 43 times that of every hydrogen atom that is replaced. There is an added advantage in acetate yarn being soluble in acetone, since waste can always be recovered in this manner, and re-spun. Disadvantages occur, however, in dyeing acetate yarn since it is impervious to the dyes used for other rayon, yarns. This may, nevertheless, be put to advantage in cross dyeing effects when acetate is interwoven with some other type of yarn, as alternated warp or weft in the manufacture of piece goods.

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GOVERNMENT OF INDIA
INDUSTRIES AND SUPPLIES DEPARTMENT

REPORT OF THE PANEL ON PAINTS AND VARNISHES

I.I BOOK
GVT. BOOK
CONNAUGHT
NEW DEL

Punjab Art Press, Lahore

PREFACE.

The Paints and Varnishes Industries Panel was constituted by the Planning and Development Department (Government of India) in their letter No. P-1 (20)/46, dated the 23rd May 1945, the members being as follows :—

Paints and Varnishes Panel.

Chairman: Mr. P. C. Chanda (initially Mr. T.T. Krishnamachari was appointed Chairman but he subsequently resigned).

Members
Mr. B. D. Gupta
Dr. R. Bhattacharya
Mr. S. L. Murarka
Mr. F. H. Kemple
Rai Sahib R. J. Kapoor
Mr. A. E. Hampson (since resigned).

2. The General Directive to Industrial Panels called for recommendations of the Panel on the following points :—

3. (1) The scope and extent of development, including the type of products recommended.

(1—A). The estimated requirements of capital goods together with such details of those requirements as may be available in India and how much should be imported from abroad.

2. Whether the industry should be under Government ownership either on grounds of national interest or because private capital is unlikely to take it up, and if so, whether it should be wholly or partly managed by Government.

3. In the case of industries to be developed other than under State ownership, the capital required for such development, whether the whole of it is likely to be available by public investment and, if not, the extent to which Government assistance may be required.

4. The extent to which technical advice from abroad may be necessary.

(4—A) The availbility and the future requirements of technical personnel so as to obtain a clearer indication of the present shortcomings and future needs.

5. The manner and the degree of co-operation with foreign firms considered necessary and desirable, both as regards capital and management.

6. The location of the industry.

7. The nature of the assistance required from Government in the form of protective duties, bounties, research grant, expert advice, etc.

(7—A). The relative incidence of the import duty on the finished goods in comparison with the duty on the raw materials from which they can be manufactured.

8. If the industry is to be under private ownership and management, what controls, if any, should be exercised by Government.

9. What should be the organisation of the different units of the industry, e.g., should there be an industrial association ? Would a carted be desirable ?

10. The stages by which the industry should be developed.

11. Should the industry cater for the export market ?

12. Should the industry be developed, as in Japan, on the cottage industry basis and if so, to what extent ?

3. In all three meetings of the Panel were held, one in Calcutta on the 23rd and 24th April, one in Simla on the 10th and 11th June, and the last in New Delhi on the 19th August, 1946. The meeting of the Panel with representatives of the Provincial and State Governments was held in New Delhi on the 23rd September 1946.

PAINTS AND VARNISHES

Introduction.

There have been remarkable developments in recent years in the Paint and Varnish Industry in the more advanced countries, the introduction of synthetic resins in the manufacture of lacquers etc., having become an important feature of the industry. The various products of the industry may be classified under the following heads :—

(1) Pigments.
(2) Paints.
(3) Varnishes and Lacquers.
(4) Enamels.

2. The start of the Paint Industry in India may be traced to the beginning of the century, the first factory having been installed near Calcutta in 1902. There has been great progress since then, however. The second world war gave the industry considerable impetus, but development was naturally limited due to exigencies of war. The immediate problem is, therefore, to remove the technological deficiency of the industry as a whole so that it may be based on a sound foundation to meet a highly competitive market the large existing demand and the still larger demand expected to develop in a few years when the contemplated schemes of railway expansion, building construction, ship building etc., will be implemented. In addition, the possibility of expanding the export market has to be kept in view.

3. The amount of capital invested in the industry has been estimated by Dr. P. J. Thomas at Rs. 150 lakhs in his "Reports in the Development of Industries for War Supplies," but we consider this low and estimate that the total capital invested is in the neighbourhood of Rs. 2 crores. Appendix I contains a list of paint factories in India.

RAW MATERIALS FOR PAINTS, VARNISHES AND LACQUERS

4. The raw materials cover a wide range of substances which may be grouped as :

(*a*) Pigments ;
(*b*) Drying Oils and Driers ;
(*c*) Resins and ;
(*d*) Solvents and Thinners ;

MACHINERY FOR MANUFACTURE OF PAINTS AND VARNISHES.

5. The machinery required for the preparation of paints and varnishes generally includes crushers, filter-presses, roller mills, edge runners, ball mills, centrifuges, driers etc. We do not propose to enter into this subject in any detail, as we understand that the Industrial Plant and Machinery Panel will deal with industrial plants required for all industries.

PAINTS AND ENAMELS.

Existing production capacity and five-year target.

6. No accurate data are available about the production capacity of paint factories in India. Taking into consideration the various figures from the different sources as regards the manufacturing capacity of paints and enamels, we are of the opinion that the existing rated production capacity of standard quality paints may be safely estimated at 50,000 tons per year. This is not sufficient even for the present needs of the country, as can be seen from the fact that in spite of the existence of a good number of factories and production of paints and enamels on an appreciable scale, imports as shown in Appendix II have persisted, although there have been small exports also (Appendix III). Taking into account the probable increased requirements of the country, as also the possibility of developing the existing small export market, we consider that the five-year target for paints and enamels only should be 100,000 tons per year. Of the increased production of 50,000 tons per year, we estimate that 25,000 tons would meet the increased demands of the internal market and the balance would be available for export.

VARNISHES.

7. Varnishes of the oil and spirit type are used extensively for giving protection and decorative effect to wood and metal, the gloss of the varnish being due to the resin present in it. Varnish medium is also used in enamels. In the Indian market, there is a large demand for the common type of varnishes, which are merely solutions of rosin or ester gum in a solvent like turpentine or white spirit. There is also a large market for varnish paints which are made merely by pigmentation of resin solution. While no special equipment or skill is necessary for manufacturing such varnishes, special types of varnishes used for coach finishes (mostly for railways), require copal gum and synthetic resin, special equipment (stainless steel and aluminium vessels) and skilled labour.

It is estimated that 25 lakhs gallons of varnishes of all types are manufactured in India annually, of which 1,35,000 gallons form superior

quality varnishes manufactured from 75 tons of copal gum and 15 tons of synthetic resin. Insulating varnishes of superior quality also require copal gum and synthetic resin. We anticipate that in five years time, the consumption of copal gum will increase to 750 tons per year, the quantity of special varnishes produced being 6 lakhs gallons. At present, such fossil gums are not available in India and have to be imported. We recommend that attempts should be made to find some Indian sources of suitable substitutes.

It may also be stated that of the 25 lakhs gallons manufactured, 15 lakhs gallons are cheap varnishes, which require little oil in their manufacture, while the balance of 10 lakhs would require about 2 lakhs gallons of drying oils.

8. With reference to the General Directive to the Industrial Panels, we wish to state as follows :—

3. (1) The scope and extent of development, including the type of products recommended.

Indian Paint Industry has so far restricted its activities to products of an ordinary type applicable to general purposes. Development of manufacture of pigments has been negligible. We are of the opinion that hereafter, the following new types should be taken up :—

FINISHED PRODUCTS

9 Enamels, paints and varnishes not being extensively manufactured now, *e.g.*, electric insulation varnishes, synthetic enamels, nitrocellulose lacquers, anti-fouling compositions and other marine paints, leather finishes, tin can lacquers etc. Of the existing lines, the stiff and ready-mixed paints should also be improved and expanded.

RAW MATERIALS

(*a*) PIGMENTS :

10. Pigments, both natural and synthetic, form one of the principal raw materials of paints, enamels and lacquers. They have also assumed considerable importance in recent years as raw materials for many other industries such as rubber goods, linoleums, oil cloth, artificial leather, plastics, ceramics etc. Manufacture of pigments has, therefore, to be regarded as a separate industry by itself and its future development will have to be considered on a wider basis. In addition to colours, they impart rust inhibitive and other protective properties to paints. Pigments may be classified on the basis of colour, origin and the properties they impart to paints.

ZINC PIGMENTS.

11. *Lithopone.* Lithopone which is composed of barium sulphate and zinc sulphide is one of the most important white pigments in the Paint Industry to-day. We understand that the estimated present requirement is approximately 4,000 tons annually, but there is no indigenous production in the country. We consider that a five-year target of 5,000 tons of lithopone per year should meet the requirements of the pigments industry. Approximately, 1,500 tons of spelter or an equivalent quantity of zinc ore to manufacture this quantity of lithopone would be required. Barytes which forms 70% of lithopone is extensively available in the country and no difficulty is anticipated in regard to the supply of this mineral.

Zinc oxide : We understand that the present production is 4,000 tons per annum mostly from imported zinc and the five-year-target is estimated to be 6,000 tons per year if lithopone manufacture is developed, otherwise, 8,000 tons.

The total spelter required for both these items : lithopone and zinc oxide would be about 7,500 tons per year and we recommend to the Government of India that they should make arrangements to obtain this quantity and make it available to the Indian Paint Industry. The requirements of the Rubber Industry would be in addition to this.

12. *Lead pigments* : Lead whites consisting of white lead and of basic sulphate are now being manufactured in India from imported lead, Indian sources of lead being negligible. Red lead and other lead pigments are also being similarly manufactured. Present production of lead pigments per annum is :

White lead	1,700	tons
Red lead	1,800	,,
Litharge	600	,,
Lead chrome	400	,,
Total	4,500	,,

We recommend a five-year-target of 8,000 tons in all for which 6,000 tons of pig lead per year would be required. It might be found possible to utilise the low grade lead ores available in India for the production of chromes, but we recommend that as a precautionary measure, Government should provide for the whole of this quantity of lead in any arrangements they might make for the import of lead for Indian Industries.

13. *Titanium Whites* comprise of titanium dioxide and certain other complexes of this with barytes and gypsum in varying proportions. At present there is no production of this pigment in the country, which is to

be greatly regretted considering that large quantities of Ilmenite and Rutile are extensively available in Travancore. We understand that during the war, small quantities of titanium dioxide were allowed to be imported. This very valuable pigment could be used to the extent of at least 3,000 tons annually, as it could replace with advantage zinc oxide, lithopone and other white pigments. This subject assumes special importance when one realises that India is poor in zinc minerals while there are plentiful supplies of titanium ores. We estimate that the quantity of titanium dioxide required for paints at the end of five years may be about 5,000-6,000 tons per year. We are sure that the Government of Travancore which contains the largest deposits of titanium-containing minerals and has, we understand, taken up the question of manufacturing titanium dioxide in the State itself, is alive to the urgency and importance of the need for local manufacture. In this connection, we would like to express our opinion that the export of titanium ores at low prices should be prohibited We feel, however, that the Travancore scheme might take some time and therefore recommend that alum sludge should be processed for recovering the titanium oxide which is present in Indian bauxite to the extent of 4-8% ; for the present, a plant for the production of 1,000 tons of titanium dioxide annually from this source is considered suitable. This is likely to be less expensive and less complicated. Even if the Travancore scheme can be put into execution early, this alternative process could still be adopted as it will enable another source of titanium dioxide available in the other parts of India to be utilised.

14. *Carbon black* of which there is no production at present in India is imported, we understand, to the extent of about 4,000 tons per year for use in paint, rubber and other industries. We do not anticipate that the paint industry will consume more than 500 tons annually during the next five years. Carbon black is generally prepared by burning waste coal tar or petroleum hydrocarbons. We recommend that attempts should be made to manufacture not only the quantity required by the Paint Industry, but also the quantity of 3,500 tons required by the rubber industry in India, in the oil refineries themselves or in factories specially installed for this purpose in the neighbourhood of oil fields. The manufacture of vegetable black is being carried out in a small way in a haphazard manner. We are of the opinion that this should be organised properly and recommend that private industrialists should be encouraged by Government to increase production by the grant of facilities for import of the necessary machinery.

15. *Aluminium powder* is, according to estimates, required to the extent of about 250 tons per year at present. We consider this an

essential pigment for paints and fix the five-year-target at 500 tons per annum. As aluminium is produced in the country, we recommend that Government should assist the industry to develop the manufacture of aluminium powder suitable for paints by permitting the import of machinery required for producing the powder.

16. *Mercuric oxide and cuprous oxide :* These are used in the manufacture of anti-fouling compositions, as toxics. The consumption is comparatively small and we are of the opinion that the target should be fixed at 50 tons each.

OTHER PIGMENTS :

The other pigments used in the Paint Industry are briefly dealt with in the following paragraphs. Since most of them are available in India in large quantities, we have not suggested any targets for them.

White Pigments and Extenders.

17. Barytes is the naturally occurring sulphate of barium, widely used on account of its cheapness; for increasing the bulk of paints rather than for its opacity. It is valued according to its whiteness. i.e., absence of colour. Good ore of pure white colour and containing over 95% of barium sulphate is extensively available in India. Blanc Fixe, which is amorphous barium sulphate obtained by chemical processes is largely used as a base for precipitating lake pigments.

Whiting is naturally occurring calcium carbonate and is the basis of all limestone rocks which are widely distributed in India, but they have not been found very suitable for the manufacture of putties and paints. It is hoped, however, that precipitated calcium carbonate obtained as a by-product in chemical industries which are expected to be started shortly, will be found to be of suitable quality.

Gypsum, the naturally occurring form of calcium sulphate, is found in enormous quantities in different parts of India. Although gypsum gives a brilliant white powder, it is not suitable for use in oil paints on account of its texture, but it is largely used as a base for water paints and distempers and as a base for water paints and distempers and as a base for striking the cheaper qualities of lake pigments.

Bauxite ores occur extensively in various parts of India. In view of the fact that Indian bauxite also contains 4-8% of titanium dioxide, it is a very valuable white pigment, when properly ground and treated. While bauxite may not be useful by itself in white paints, it can take the place of barytes and other extenders and to some extent, of pigments, in many coloured paints. We would refer to the tendency in paint industries in

foreign countries to utilise Indian bauxite for the recovery of titanium pigment. We would refer to the manufacture of titanium dioxide from alum sludge recommended in para 13.

China clay occurs widely in various districts of India, but the pure white variety is not common. Most of the clay beds are partly discoloured by various impurities, notably iron oxide, carbon or other organic matters, which have to be removed before China clay could be used as a pigment.

Mica. Of the many varieties of mica, the one which is most suitable for use as a paint material is a pure muscovite or white potash mica largely found in India. Ground mica is used for fire-and heat-resisting, and ornamental paints and pigments. We understand that large quantities of waste mica available at the various mine-sites are not being utilised at present. These could be used in the Paint Industry.

Silica is also used in special paints.

18. **Red Pigments:**

Red Ochres which owe their red or reddish brown colour to anhydrous ferric oxide have been used as pigments from ancient times. Ochres of various shapes and different degrees of fineness occur widely in India.

Iron Reds are prepared from waste products in other branches of manufacture, specially metallurgical operations, manufacture of galvanised iron etc. By regulating the temperature and time of calcination a range of tints from broken orange red to deep purple brown can be produced, these being known in the trade as Turkey-reds, Indian-reds, purple brown, Venetian reds etc. These pigments when properly prepared are very fine and uniform in texture, possess great spreading power and opacity and have, therefore, decided advantages over natural products like red ochres. They are manufactured in India, but they are inferior in shade and texture and require improvement.

19. **Yellow Pigments :**

Natural Earth-Ochres and Siennas : In their natural condition ochres and siennas consist mainly of clay, coloured by varying amounts of hydrated iron oxide associated with other metallic hydrates, notably that of manganese. When the metallic oxide is almost entirely iron, the colour is yellow, varying in brightness and strength according to the percentage of iron hydroxide. The earths are know as ochres when clay predominates and as siennas when iron hydroxide is present in a major proportion. The yellow colour of ochres can be modified to red by heating them to dull-red heat. Pigments from these are made in India.

Yellow Chromes : The chromates of lead, barium, zinc and strontium, generally known as chromates, are the important yellow pigments of inorganic origin and form an important group of pigment varying in colour from pale yellow to deep orange. The basis of most of the chrome pigments is yellow chromate of lead or its reddish orange basic derivative, usually called chrome orange. Zinc yellow, a complex salt of zinc oxide and potassium dichromate is also an excellent rust inhibitive pigment. Many firms are manufacturing lead chromate in India from chromite ores which are extensively available.

Yellow oxide of iron is another pigment resembling a first class yellow ochre in appearance and properties, but it has a staining power several times greater than that of the finest natural ochre. It is widely used on account of its great staining power and freedom from grit.

Cadmium Yellow which is cadmium sulphide is an important yellow pigment for paints, especially for high-class decorative work such as coach-painting etc. No cadmium ore capable of commercial exploitation is known to occur in India.

20. **Green Pigments :**

Terre Verte or Green Earth is a natural earth consisting of the mineral galuconite and owes its colour to the presence of a large proportion of silicate of iron. The finest and richest varieties are used as artist's colours whilst inferior grades are used as a base for the preparation of green 'lakes'. Small quantities of green earth are available in India. This pigment which was favoured by old-time decorators both in India and abroad, is being gradually replaced by other synthetic pigments.

Chrome Green or Brunswich Green is a mixture of a small proportion of Prussian blue with chrome yellow. It is an important green pigment and can be manufactured from local raw materials.

Chromium Oxide is a valuable green pigment, possessing great opacity and resistance to sunlight, as it can be heated to redness without alteration and is not attacked by acids or alkalies. Its use as a paint pigment has increased considerably in recent years and it is also largely employed as a rubber pigment, as it is not affected by sulphur. Small quantities of chromium oxide are being manufactured in India by some firms. We consider that there is considerable scope for developing the manufacture of this pigment in India, since the raw material, dichromate is manufactured in large quantities in India

21. **Blue Pigments.**

Ultramarine Blue is, in addition to its use in paints, also largely used in laundry work, paper manufacture and for correcting the colour of sugar

and starch. Though many of the raw materials are locally available, manufacture of this pigment in India has not been successful. This requires investigation.

Prussian Blue, one of the oldest chemical pigments, is, it is understood, being made in small quantities in India at present.

22. Black pigments :

Graphite occurs in small quantities in various parts of India. The deposits contain about 50 to 60% carbon and can be used for black paint manufacture. Graphite possesses great opacity and spreading power and is used by itself or in combination with other pigments, principally in paints for metals.

23. Lake Pigments :

Lake pigments form an important class produced by precipitating an organic dyestuff on a mineral base. Natural indigo, carmine etc., have now been completely superseded by synthetic dyes from coal-tar derivatives. Pigments in a complete range of colours are now produced by this method. These have assumed great importance in the paint industry in recent years. At present some lake pigments are made in India with imported dyestuffs.

It is seen from the preceding paragraphs, that most of the pigments belong to the class of minerals, about which full information is not available. We are of the opinion that the Geological Survey of India should pay special attention in their surveys to this aspect of the question.

(B) DRYING OILS AND DRIERS.

24. Drying Oils :

India is one of the principal producers of linseed in the world, production being of the order of 400,000 tons per year, about a half of which is exported. The internal consumption of linseed has appreciably increased during recent years. Castor oil is not a drying oil, but when dehydrated by heating it in the presence of a catalyst (alumina, silica gel, fuller's earth or sulphuric acid) under reduced pressure, the oil loses weight and develops excellent drying properties. The use of dehydrated castor oil in paints and varnishes has developed recently ; this can be adopted in India also with advantage as castor oil resources of India are very large.

Tung oil is produced only in small quantities in India at present, but its importance is too great to be ignored from the point of view of

modern paints and varnishes. We recommend that the question of developing tung plantations should be taken up early.

Poppy, soya bean and some other oils are also used in small quantities.

It is estimated that about 15,000 tons of drying oils consumed at present by the paints industry annually will increase, in five years time, to at least 30,000 tons per year. Linseed oil is the main drying oil, but as already stated, recent developments indicate that better types of enamels and varnishes are made in other countries from tung oil or its substitutes like dehydrated castor oil and isomerised linseed oil. Therefore, we consider that out of this 30,000 tons of drying oils required per year, 25,000 tons would be linseed oil and the balance of 5,000 tons would be of the type of synthetic drying oils or of modified castor or linseed oils. As the estimated production of linseed and castor in the country is more than sufficient, no difficulty is anticipated in meeting this increased demand. In this connection, we should like to refer to the restrictions placed by the linseed-producing provinces on the free movement of the commodity to other provinces as a result of which Indian paint industry is suffering. We are of the opinion that this restriction should be removed and free movement permitted.

25. Driers :

The important 'driers' in general use for the purpose of accelerating the drying property of oils are lead compounds, such as litharge, red lead and lead borate, manganese compounds such as manganese dioxide, sulphate and borate, and organic driers, such as rosinates, linoleates, acetates, oxalates and naphthanates of lead, cobalt and manganese. It is understood that many of these driers are produced in India at present.

RESINS.

26. *Lac* resin is an important raw material of the paint and varnish industry and is marketed as shellac. The annual production of crude lac in India has been estimated to vary between 30,000 tons to 40,000 tons, a large proportion of which is exported from India.

Rosins are obtained by distillation from the oleoresin of pine trees and are largely used in Paint and Varnish Industries. A number of rosin and turpentine factories are working successfully in Northern India.

Synthetic resins : There is very little production of synthetic resins in India. Only recently one factory has been producing small quantities of one of the raw materials, viz., phthalic anhydride. We estimate that 2·5 lakhs gallons of synthetic varnishes and enamels could be used in the

country per year, which would require about 500 tons of oil-modified glyptals made from 150 tons of phthalic anhydride and 150 tons of glycerine. We understand that the supply of glycerine in the country is sufficient and recommend that immediate steps should be taken to develop the production of phthalic anhydride. As the manufacture of phthalic anhydride can only be carried out in small units, several units would be necessary.

Other miscellaneous products : Resin from the so-called Dhobi's nuts (Marking nuts) which grow wild in some parts of India have been recently introduced in paints and varnishes Cashew nut oil also is used. "Gub" resin obtained from green fruits of "Gub" trees which grow wild in Bengal, specially East Bengal, is largely used for caulking boats in Bengal.

(D)—SOLVENTS AND THINNERS.

27. *White spirit or mineral turpentine.* We understand that the present consumption of this solvent in paints is approximately 8·5 lakhs gallons and in varnishes, 15·5 lakhs, making a total of 24 lakhs gallons. We consider that during the next five years, this would increase to about 20 lakhs gallons for paints and 20 lakhs for varnishes, making a total of 40 lakhs gallons per year. We believe the oil companies in India would be able to supply most of this quantity and any deficit will have to be made up by imports.

Turpentine is obtained by distilling the oleo-resin of pine trees in a number of factories in India as mentioned under "Rosin". It may be mentioned here that about 4 lakhs gallons of vegetable turpentine are produced in India and consumed by the Paint Industry.

Coal-tar distillates consisting mainly of benzol and solvent naphtha are produced in the country and used in the Paint Industry as thinners.

28. **Alcohols and their esters and Acetone :**

Alcohols and their esters are largely used in the varnish industry. Methyl and ethyl alcohols are solvents for shellac while butyl and amyl alcohols and their acetates are required in the formulation of cellulose lacquers. Acetone also is used. These solvents and thinners are consumed to the extent of 1·2 lakhs gallons per year. Taking into account the developments which we anticipate will take place in the next five years, we are of the opinion that a target of 3 lakhs gallons per year should be aimed at. For this purpose, 60,000 gallons of butyl alcohol and 300 tons of acetic acid would be necessary for the manufucture of butyl acetate. Butyl alcohol and acetic acid are now manufactured only to a small extent. We recommend to the Government of India to make suitable arrangements

for the production of these by fermentation of molasses and by manufacture from alcohol respectively. We understand, however, that an import licence for a plant of capacity 600 tons of acetic acid per year to be located in the U. P. has been granted. Since acetic acid would be required in other industries also, we suggest that the requirements of the Paint Industry may be pooled with other demands and proper arrangements for the total quantity may be made by Government.

The quantity of amyl alcohol made from fused oil is negligible. This requires to be developed.

Civilian demand for acetone is at present small, but is likely to go up. We recommend that Government production at Aruvankadu be released to the paint and other industries, since the demands of the War Department are reduced. We understand that an import licence has been given for a 300-ton-per-year acetone plant to be located in the U. P., the manufacture to be from alcohol.

29. *Cellulose nitrate and other forms of cellulose used in lacquers*: The average cellulose content of lacquers is 1 lb. per gallon and on this basis, we estimate that about 15,000 lbs. of cellulose of the required quality (particularly low viscosity cellulose nitrate) required for 15,000 gallons of lacquers are being consumed at present. We anticipate that consumption of these will increase by a lowering of the cost of production and therefore, fix the target at 50,000 gallons of lacquers, requiring 50,000 lbs. of nitrocellulose. We understand that the Cordite Factory at Aruvankadu is equipped for the production of cellulose nitrate for explosives and recommend that this factory should also undertake production of cellulose nitrate suitable for lacquer manufacture.

30. 3(1—A) *Estimated requirement of capital goods:* It is common knowledge that the existing equipment in paint factories has been overworked during the war period and we consider that replacement of most of it is essential if the existing factories have to work efficiently. Although it would be difficult to give a correct estimate without knowing the conditions in all the factories, on a rough approximation we estimate that the capital goods requirement for this purpose would be Rs. 30 lakhs. For the extra production of 50,000 tons per year, we consider that it should be arranged by increasing the capacity of the existing plants by 21,500 tons per annum and by providing for fresh capacity of 28,500 tons by the installation of new plants in those areas where the industry does not exist at present or has been developed only to a small extent, provided there are other facilities such as availability of raw materials etc. and market. For these new plants, we consider 5-ton-per-day units suitable

and economical and for the extra production of 28,500 tons, 19 such units would be necessary. It is estimated that each 5-ton unit would cost Rs. 2·25·3-25 lakhs, of which Rs. 1·5-2·5 lakhs would be the cost of goods to be imported depending on the type of machinery required and Rs. 0·75 lakh would be the cost of locally manufactured machinery. Therefore, imported capital goods requirements for the new plants may be estimated at Rs. 47·5 lakhs. For achieving an additional capacity of 21,500 tons in the existing factories, we estimate that Rs. 22·5 lakhs worth of equipment would be necessary. Therefore, Rs. 100 lakhs may be taken as the total capital goods requirements for the next five years so far as paint manufacturing equipment is concerned. In addition, it would be necessary to import capital goods for the manufacture of pigments such as titanium dioxide, lithopone, zinc oxide and aluminium powder. We estimate that Rs. 50 lakhs would be required for this purpose, making a total of Rs. 150 lakhs, which may be taken as the complete capital requirements for the whole of this industry. All the machinery required may not be available in the sterling area and we recommend to Government that they may make available to the industry such other currencies as may be required.

3 (2) Purely under private management.

3 (3) Same as 3 (1—A)

3 (4) Any small advance made by the Indian paint industry during the war was restricted mostly to finished products. Production of pigments and other raw materials of the industry is negligible. We consider that further improvement and development are essential and in order to achieve speedy progress, we recommend that Government should assist Indian Paint manufacturers to obtain the necessary foreign technical personnel and advice, specially for the development of raw material production. We would lay special stress on the desirability of importing technicians from Germany, who, we understand, are available for employment. Indian Paint Industry would derive little benefit if they are employed only for short periods. We are of the opinion that 3 years should be the minimum period of contract. We consider that each large factory would require one factory manager, who will be an experienced paint technologist and one chief chemist experienced in paint manufacture and analysis.

3 (4—A) We consider the available technical personnel in India insufficient and for future technical staff required by the industry, we recommend that in addition to the personnel that may be trained in India in the Universities and other Institutions, people already employed in the industry should be given facilities by Government on the

basis of 10 technical men per year to go abroad for specialised studies. We feel sure that Government is alive to the urgency of this problem. We may refer to the Central Paints Laboratory recommended in 3 (7), which we consider, should be the training centre for the technical personnel for the industry.

3 (5) Unnecessary.

3 (6) Fresh capacity to the extent of 28,500 tons per year, i.e., about 95 tons per day has been recommended in 3 (1—A). For the extra production, we recommend that plants should be installed as follows :—

Madras Presidency	...	10	tons	per	day.
United Provinces	...	10	,,	,,	,,
Bihar	...	10	,,	,,	,,
Central Provinces	...	10	,,	,,	,,
Bombay Presidency	...	5	,,	,,	,,
Punjab	...	5	,,	,,	,,
Assam	...	5	,,	,,	,,
Orissa	...	5	,,	,,	,,
Sind	...	5	,,	,,	,,
N.W.F.P.	...	5	,,	,,	,,
Hyderabad State	...	5	,,	,,	,,
Travancore and Cochin States	...	5	,,	,,	,,
Rajputana States	...	5	,,	,,	,,
Eastern States	...	5	,,	,,	,,
Gujerat States	...	5	,,	,,	,,
		95	,,	,,	,, or

about 28,500 ton per year.

There is need for paints and varnishes in every part of the country and we are of the opinion that this industry should be as widely distributed as possible, taking into consideration the availability of raw materials and the extent of the market. The allocation of fresh capacity has been made on this basis.

Since the industry is already concentrated in Bengal, we are of the opinion that no new plants should be permitted to be installed in this Province. The industry is well developed in Bombay and Punjab also and therefore only one plant has been allotted to each ef these Provinces. It must be remembered, however, that there will be increased capacity to the extent of 21,500 tons by expansion of the existing plants and a good portion of this will be allotted to these three provinces. We recommend that in the allocation of expansion capacity, factories of less than 5 tons

capacity per day should be given the first preference for bringing up their production to the minimum economic 5 ton level and next, the smaller factories of more than 5 tons-per-day capacity should have preference over larger factories.

3 (7) In order to increase the efficiency of the industry and ensure the maintenance of a high standard in the quality of the paints and other products manufactured in India and for carrying out all investigations related to this industry, we strongly recommend that a Central Paints Laboratory should be started immediately by Government in consultation with the industry. This will be the central authoritative technical institution for the whole of the Indian Paint Industry. As already stated in 3 (4—A), we are of the opinion that this Laboratory should also be the training centre for the technical personnel required by the paint factories in India. To enable this to be done satisfactorily and also for the proper conduct of all other work, we recommend that the Laboratory should be well-equipped with the latest types of pilot plant scale machinery and staffed by men of high standing in paint technology.

3 (7—A) We do not consider any change necessary for the present.

3 (8) and 3 (9) In order to safeguard the interests of the industry, we recommend that a Central Association of all paint manufacturers in India should be formed and it must be made compulsory for all manufacturers of paints and varnishes in the country to register themselves as members of this Central Association. This Association should be the authoritative body to advise the Government periodically on the development of the industry and as to the controls to be exercised by Government.

We recommend further that this Central Association which will be responsible for the maintenance of high standards in the industry should be consulted by Government in drafting specifications for Paints and Varnishes. No cartel is desirable.

3 (10) As the country has suffered considerably during the war for want of a sufficient supply of paints and new post-war schemes would require large quantities of paints in addition to usual civilian requirements, we are of the opinion that immediate steps should be taken to develop the industry.

3 (11) There has always been a small export market for Indian paints; pre-war average annual export was about 40·5 tons which, however, registered a sudden increase in 1941-42 to 73 tons; but there was a rapid decline in 1943-44 to about 7 tons. We feel that with sufficient

propaganda and official help, this export market for which we have fixed a target of 25,000 tons per year can be developed considerebly. Therefore, we recommend that Government should direct its Trade Commissioners and Commercial Attaches stationed in other countries to pay special attention to the expansion of the existing small exports for paints and varnishes in countries like China, Burma, Afghanistan, Iran, East Africa, Egypt and Federated Malaya States. We are sure the industry will not be found wanting in accepting its share of responsibility.

3 (12) We do not consider that this industry can be developed on a cottage industry basis.

31. Although the Printing Ink Industry does not strictly fall within the purview of this Panel, it is an allied industry requiring similar raw materials and machinery, and we recommend that Government should give special encouragement for the establishment and development of this important industry in India.

ACKNOWLEDGMENTS.

We wish to record our appreciation of the valuable work done by Dr. K. A. N. Rao, the Secretary of the Panel, which facilitated the work of the Panel considerably. Our thanks are also due to his staff for their good work.

P. C. Chanda — Chairman.

S. L. Murarka.

B.D. Gupta.

F. H. Kemple.

R. Bhattacharya.

R. J. Kapoor.

K. A. N. Rao Secretary.

APPENDIX I.

LIST OF PAINT MANUFACTURERS IN INDIA.

Calcutta Area :

*1. Messrs. Shalimar Paint Colour and Varnish Co. Ltd., 6, Lyons Range, Calcutta.

*2. Messrs. Jenson & Nicholson (India) Ltd., 2 Fairlie Place, Calcutta.

*3. Messrs. Napier Paint Works, 3, Matisil Street, Calcutta.

*4. Messrs. Murarka Paint & Varnish Works, Ltd., 4-E, Dalhousie Square, Calcutta.

*5. Messrs. Hadfields (India) Ltd., 12 Mission Row, Calcutta.

*6. Messrs. Hoyle Robson & Barnett & Co., Ltd., 4-E, Dalhousie Square, Calcutta.

*7. Messrs. Macfarlane & Co., Ltd., 18 Tangra Road, Entally, Calcutta.

8. Messrs. Calcutta Paint Colour & Varnish Works, 6, Chunpukur Lane, Calcutta.

*9. Messrs. Solar Paint & Varnish Manufacturing Co., Barrackpore Trunk Road, P. O. Belgharia, 24 Paraganas, Calcutta.

10. Messrs. Standard Paint Works, 44 Beaden Row, Calcutta.

11. Messrs. India Paint Colour & Varnish Co., Ltd., 161/1 Harrison Road, Calcutta.

*12. Messrs. P. C. Chanda & Co., 11-12 Bechulal Road, Entally, Calcutta.

13. Messrs. Jay Engineering Works, P. O. Box No. 3158, Calcutta.

14. Messrs. Eastern Paint & Varnish Co., 36, Dum Dum Road, Calcutta.

15. Messrs. J & R. Hutchison, 19, Dum Dum Road, Calcutta.

16. Messrs. East India Paint & Chemical Works, 103A, Surendra Nath Banerjee Road. Calcutta.

Bombay Area :

*1. Messrs. Goodlass Wall (India) Ltd., Post Box No. 663, Bombay.

*2. Messrs. Elephant Oil Mills Ltd., Post Box No. 669, Bombay.

3. Messrs. Hyderabad National Industries, Station Road, Hyderabad.

*4. Messrs. Cooper & Co., 53, Abdur Rahman Street, Bombay.

5. Messrs. Sun Colour & Paint Manufacturing Works, Jamnagar, Kathiawar.

6. Messrs. Hard Castle Waud & Co., Ltd., Alice Buildings, Hornby Road, Bombay.

7. Messrs. John Fleming & Co., Bastion Road, Bombay.

8. Messrs. Flintrock Products, Belvedre Hill Road, Mazagon Road, Bombay.

9. Messrs. Hyderabad Oil & Paint Co., Ltd., Hyderabad.

Karachi Area :

1. Messrs. Punjab Paint Colour & Varnish Works, Outside Mochi Gate, Lahore.

*2. Messrs. Ravi Paint Colour and Varnish Works, Lahore.

*3. Messrs. Crescent Paint Colour & Varnish Works, Canal Park, Lahore.

4. Messrs. Anglo Duch Paint Colour & Varnish Works, Anarkali Street, Lahore.

Other Areas :

1. Messrs. Prem Company, Karol Bagh, Delhi.

2 Messrs. Jyoti Paint & Varnish Industries, Amjikarai, Madras.

3. Messrs Roshanara Paint Colour & Varnish Works, Subzimandi, Delhi.

4. The Mysore Government Lac & Paint Works, Mysore.

5. Messrs. Gwalior Paints, Gwalior.

List of Pigments and Colour Manufacturers :

1. Messrs. D. Waldie & Co., Ltd., Konnagar, Bengal, (Mg. Agents of Messrs. Gillanders Arbuthnot & Co., 8 Clive Street, Calcutta.)

2. Messrs. Indian Red Lead Factory, 9 Clive Street, Calcutta.

3. Messrs. Shori Lal Jai Lal & Sons, Amritsar.

4. Messrs. M. L. Ghosh & Co., 18-G, Windsor Place, Calcutta.

Note : *The large well-established Paint Factories.

APPENDIX II

Imports of Paints & Varnishes into British India.

	Average Quantity in Cwts. (000)						Value in Rupees (000)					
	1924—25 to 1928—29	1928—29 to 1932—33	1934—35 to 1938—39	1941—42	1942—43	1943—44	1924—25 to 1928—29	1928—29 to 1932—33	1934—35 to 1938—39	1941—42	1942—43	1943—44
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
PAINTS & COLOURS												
1. Barytes ...	25	67	17	1	(a)	(@)	94	1,85	55	12	5	10
2. Blue Paint or Paris Blue ...	2	9	16	13	9	7	1,40	4,08	9,96	10,76	7,38	7,10
3. Graphite ...	6	10	10	7	15	3	1,26	1,45	1,35	1,77	4,90	1,24
Enamels prepared.**	10						7,60					
1. Red Lead ...	32	33	20	11	2	(c)	8,99	6,19	2,99	78	67	6
1. Reduce dry. ...	1	1	2	(a)	...	...	15	10	29	10	@	...
5. White Lead ...												
i. Genuine dry ...	13	11	11	6	1	...	3,93	2,66	2,23	1,97	40	...
ii. Reduced dry ...	...	...	(c)	...	...	...	...	...	3	@	...	...
iii. Genuine moist ...	10	4	2	(a)	(@)	(c)	3,41	66	52	21	27	11
iv. Reduced moist ...	2	1	1	(c)	(d)	(a)	53	47	30	10	1	9
6. Lithopone ...	...	7	28	36	32	29	...	86	2,41	7,81	7,56	7,17
i. White moist ...	...	...	1	...	...	@	·6	...	23	...	...	11
7. Zinc " white ...	9	'13	3	1	3	...	1,99	2,71	62	29	94	...
i. Reduced dry ...	c	1	1	d	...	...	...	24	10	3	...	...
ii. Genuine moist ...	33	28	27	6	a	a	12,07	8,31	7,05	2,26	12	14
iii. Reduced moist ...	9	7	1	d	c	...	2,16	1,41	13	2	6	...
8. Other sorts ...	241	111*	110	81	62	39	...	25,47	28,76	26,22	...	16,12

i. White dry ...	...	17	1	o	a	...	65,09	2,47*	22	12	10	...
ii. White moist ...	...	11†	7	4	2	2	...	2,09*	22,09	21,78	1,91	1,92
iii. Coloured moist ...	...	10†	72	52	26	10	...	25,41†	22,57	28,65	14,92	6,54
iv. Coloured dry ...	...	71	101	67	45	33	...	3,33†	20,84	34,86	25,95	22,58
Total Paints & Colours.	393	412	321	204	135	84	1,09,58	89,76	74,48	91,59	64,24	46,16
Painter's material (other than Paints & Colours)												
1. Turpentine ...	4	4	4	8	35	20	2,46	1,39	82	89	3,43	1,96
2. Substitute (Turp)...	4	2	45	67	35	11	84	47	2,49	7,58	3,04	1,88
3. Varnishes :—												
(a) Enamels ...	...	5	1	f	@	d	...	2,75	65	67	50	37
(b) Lacquers ...	...	@	d	a	d	d	...	24	9	33	4	4
(c) Other kinds ...	...	29	23	8	4	4	...	15,82	10,48	5,43	2,89	3,89
Total (Varnishes) ...	32	34	24	9	5	5	20,37	14,49	11,00	6,43	3,44	4,30
Total Painter's Material (other than Paints & Colours) ...	40	40	73	84	75	36	23,67	16,35	14,31	14,90	9,91	8,14
Total Paints and Varnishes (Tons) ...	22,000	23,000	20,000	14,000	11,000	6,000	1,33,25	1,06,11	88,79	1,06,49	74,15	54,30

*Average from years 1928-29 to 1929-30
...Details not available. @Below 100 Cwts.
d Below 100 Cwts. @Below 50 Rupees.

†Average from years 1930-31 to 1932-33
a Below 500 Cwts. c Below 200 Cwts.
...Negligible. **Shown under varnishes from 1930-31.

APPENDIX III.

Export of Paints and Varnishes from India.

KIND	Quantity in Cwts. (000)						Value in Rupees (000)					
	1924—25 to 1928—29 (av) (1)	1928—29 to 1932—33 (av) (2)	1934—35 to 1938—39 (av) (3)	1941—42 (4)	1942—43 (5)	1943—44 (6)	1924—25 to 1928—29 (av) (7)	1928—29 to 1932—33 (av) (8)	1934—35 to 1938—39 (av) (9)	1941—42 (10)	1942—43 (11)	1943—44 (12)
PAINTS & COLOURS.												
Graphite ...	d		e	a	1	d	2	†	†	7	25	6
Other sorts ...	18	19	81	160	50	15	2,15	1,72	5,79	20,76	5,07	6,39
Other than Paints, and Colours.												
Turpentine ...			10	5	e	a			1,50	1,29	5	27
Other sorts ...									6	1,03	10	28

a=Below 500 cwts. d=Below 100 cwts. e—Below 50 cwts. x—Negligible
†—Below Rs. 100. x=negligible

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REPORT

OF THE

PANEL ON READYMADE CLOTHING INDUSTRY

GOVERNMENT OF INDIA

DEPARTMENT OF INDUSTRIES & SUPPLIES

1946

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SUMMARY OF RECOMMENDATIONS.

The Panel recommends that five readymade clothing factories should be established during the next five year period. Each factory should have a minimum production capacity of 10,800 garments per day.

2. These factories can with advantage be located at the following places :—

1. Madras. 2. Bombay. 3. Calcutta. 4. Delhi. 5. Jullundur.

3. The industry should be entirely owned by private enterprise. No foreign co-operation both as regards capital and management is considered necessary.

4. A plant producing 10,800 garments per day is considered as the minimum economic unit under present conditions.

5. Regarding Government assistance and controls the Panel recommends that a special officer with high technical qualifications and administrative experience should be appointed to watch and guide the interests of the industry. There should be Government control over marketing and distribution of products, supply of materials, prices, designs and specifications and wages.

6. The industry does not need any protection under present conditions.

7. The Panel recommends that modern and up-to-date machinery should be imported. The Government should also release the necessary dollars required by the industry for the import of capital goods from the United States of America.

8. Capital goods worth about Rs. 35 lakhs will be required by the industry during the next five year period.

9. The Panel recommends that at least twelve young Indians should be sent abroad every year by the Government for higher technical training in the different branches of this industry during the next five year period. Arrangements for the training of lower technical personnel such as tailors, supervisors etc., should be made at the proposed Government polytechnics which are to be established in the industry.

S. JAJODIA. Chairman.

NARINDER SINGH.
S. R. KHANDKE.
S. R. KHANDKE
(for D. N. KHANDKE). Members.

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APPENDIX I.

STATEMENT SHOWING FIGURES OF SKILLED, SEMI-SKILLED, UNSKILLED AND SUPERVISORY STAFF EMPLOYED IN THE ORDINANCE CLOTHING AND PARACHUTE FACTORIES IN DECEMBER 1944.

Clothing Factories—	
1. Skilled	8,797
2. Semi-skilled	1,843
3. Unskilled	5,810
Total	16,450
Supervisory	2,214
Parachute Factories—	
1. Skilled	6,381
2. Semi-skilled	1,513
3. Unskilled	5,530
Total	13,424
Supervisory Staff	1,502
Total of Labourers	29,874
Total of Supervisory Staff	3,816
GRAND TOTAL	33,690

APPENDIX II.

LIST OF ORDNANCE CLOTHING AND PARACHUTE FACTORIES AND BRIEF DETAILS OF SIZE AND TERMS OF OCCUPATION.

Shahjahanpur.

Floor space, 282,000 sq. ft. (excluding 9,000 sq. ft. occupied by the Chief Inspectorate, Clothing Factory, Stores).

Land and buildings are Government property.

Pre-war permanent structure and war extensions partly of permanent, partly of temporary construction ; available for post-war occupation.

Cawnpore.

Main factory—

Floor space, 62,000 sq. ft.

Land and buildings are Government property.

Main building a modern industrial building of permanent construction (P.W.D. 1942) air-conditioned. Subsidiary buildings, part permanent, part temporary construction; available for post-war occupation.

K. E. M. Hall—

Floor space, 34,800 sq. ft. on two floors.

Rented from local civil authorities for Rs. 250 per month. Unlikely to be available for post-war use as a factory, as it is situated in a park and will presumably be required for other purposes.

Sialkot Clothing Factory.

Edwards Hanger—

Floor space, 65,366 sq. ft.

Government land and buildings—main hanger on loan from M.G.O. subsidiary buildings—perimeter wall of temporary construction erected by Supply Department. Location in the middle of the Cantonment. Possibility of post-war retention for factory purposes doubtful.

Gujrat Hanger—

Floor space, 53,250 sq. ft.

Government land and buildings on loan from M.G.O.—location in the middle of Cantonment. Possibility of post-war retention for factory purposes doubtful.

Palaise-de-dance—

Floor space, 23,269 sq. ft.

Main building rented from Messrs. Ishar Das Sahni & Bros., Sialkot at Rs. 250 per month, subject to 3 months notice.

Subsidiary buildings and perimeter wall of temporary construction erected by Supply Department.

Possibility of post-war retention for factory purposes doubtful.

Poonch House (Lahore)—

Floor space, 49,000 sq. ft.

Main building requisitioned through the Deputy Commissioner, Lahore, from the Rani of Poonch, on monthly rental of Rs. 1,050 subject to restoration to original state on vacation.

Subsidiary buildings of temporary construction erected by Supply Department.

Possibility of post-war retention for factory purposes doubtful.

Sialkot Parachute Factory.

Floor space, 171,000 sq. ft.

Main buildings of temporary construction on Cantonment land, inspection located in Ramjidas building purchased by Supply Department.

Possibility of post-war retention for factory purposes doubtful.

Lahore Parachute Factory.

Floor space, 274,000 sq. ft.

Located on N.W.R. land. Half the buildings rented from N.W.R. half erected by Supply Department. Monthly rental Rs. 2,329.

Will almost certainly not be available for post-war retention.

Madras.

Floor space, 120,000 sq. ft.

Main buildings are old Army Clothing Factory buildings rented from the Madras Government at Rs. 1,468 per month plus taxes. Additional buildings of temporary construction erected by the Supply Department.

Possibility of post-war retention for factory purposes doubtful.

The following outside buildings are also in use in Madras :—

1. *Chitra Talkies*, 20,000 sq. ft. rented through Collector at Rs. 700 per month; on one month's notice.

2. *Godowns*, 35,000 sq. ft. rented from M/s. Dinrose Estate, Addison & Co. and M/s. A. M. Ghulam Ali at Rs. 1,390 per month on one month's notice.

Secunderabad.

Begumpat Palace, 33,000 sq. ft.

Placed at Government's disposal by H.E.H. the Nizam's Government for the duration of the War rent free, subject to restoration to original state on vacation.

Subsidiary buildings of temporary construction erected by Supply Department.

Bombay.

Floor space, 172,000 sq. ft. on three floors in a building rented from M/s. Modern Mills Ltd., at Rs. 3,880 per month. The lease is terminable six months after the cessation of hostilities.

Possibility of post-war retention doubtful.

The following outside building is also in use :—

Arthur Road Garage, 13,660 sq. ft. rented from the Bombay Municipality at Rs. 350 per month. Possibility of post-war retention doubtful.

Agra.

Floor space, 154,000 sq. ft.

Buildings consist of three bungalows placed at disposal for the duration of the war (rent free, subject to restoration to original state on vacation) plus buildings of temporary construction in the same compound, erected by the Supply Department.

Possibility of post-war retention doubtful.

The following outside building is also in use :—

Laxmi Mills, 27,000 sq. ft. on two floors, rented from M/s. Sudeshi Bima Co., Agra at Rs. 688 per month. Possibility of post-war retention doubtful.

INTRODUCTION.

The Government of India in the Department of Planning and Development constituted a Panel to consider and advise them regarding the possibilities of the establishment of the Readymade Clothing Industry in India. The Panel consisted of the following:—

Chairman.

Mr. S. Jajodia.

Members.

Mr. D. N. Khandke.

Sardar Bahadur Narinder Singh, MBE.

Mr. S. C. Nawn.

Secretary.

Mr. A. S. Bhatnagar, Assistant Industrial Adviser.

Mr. M. H. Mahmood acted as the Secretary of the Panel upto the 12th October 1945.

Mr. S. R. Khandke was subsequently co-opted as member of the Panel.

Mr. S. C. Nawn was unable to attend any meeting of the Panel.

II. The following general directive was issued by the Government of India to indicate the scope of the Panel and the procedure to be followed by it.

GENERAL DIRECTIVE.

It is the function of panels to make recommendations to Government regarding the development of industries, both existing and new. These recommendations should be so framed as to enable Government to prepare a detailed phased plan for the five years following the cessation of hostilities, as the first stage of a 15-year plan of industrial development for the whole country.

2. In order to assist them to formulate recommendations, panels will be supplied, as far as possible, with factual information prepared by the panel secretaries. In the case of new industries, the information will consist of a general survey of the industry and the importance of starting it in India, the availability of raw material, the power requirements, the demands of the markets and the probabilities of exports. In the case of existing industries, the information will naturally be more comprehensive ; it will indicate in addition, the location of existing units, the types of goods produced, the total production under each category and the assistance, if any, given by Government. These items are to be regarded as illustrative and not exhaustive.

Government will give each panel, as a basis, for discussion, the provisional target to be aimed at in the first five-year period and, wherever possible, of the target to be reached in 15 years.

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3. The recommendations of the panels should cover the following points :—

(1) The scope and extent of development, including the type of products recommended.

(1-A) The estimated requirements of capital goods together with such details of those requirements as may be available in India and how much should be imported from abroad.

(2) Whether the industry should be under Government ownership either on grounds of national interest or because private capital is unlikely to take it up, and if so, whether it should be wholly or partly managed by Government.

(3) In the case of industries to be developed other than under State ownership, the capital required for such development, whether the whole of it is likely to be available by public investment and, if not, the extent to which Government assistance may be required.

(4) The extent to which technical advice from abroad may be necessary.

(4-A) The availability and the future requirements of technical personnel so as to obtain a clearer indication of the present shortcomings and future needs.

(5) The manner and the degree of co-operation with foreign firms considered necessary and desirable, both as regards capital and management.

(6) The location of the industry.

(7) The nature of the assistance required from Government in the form of protective duties, bounties, research grant, expert advice, etc.

(7-A) The relative incidence of the import duty on the finished goods in comparison with the duty on the raw materials from which they can be manufactured.

(8) If the industry is to be under private ownership and management, what controls, if any, should be exercised by Government ?

(9) What should be the organisation of the different units of the industry, e.g., should there be an industrial association ? Would a cartel be desirable ?

(10) The stages by which the industry should be developed.

(11) Should the industry cater for the export market ?

(12) Should the industry be developed, as in Japan, on the cottage industry basis and, if so, to what extent ?

4. Although, as stated above, the Panels may recommend the grant of protection, it will not be their function to consider broad questions of international trade and commercial policy.

5. Joint meetings of the panels should be held, wherever necessary, to secure co-ordination particularly where the processes and the products of one industry are connected with those of another.

6. Some of the panels have been drawn broadly and it may be necessary to co-opt members for dealing with specific branches of the industry. Members may be co-opted by the Chairman in consultation with the Industrial Adviser.

7. Before submitting recommendations, panels should consult Provincial Industrial Committees, particularly in the matter of location of industry. They should also, where the circumstances of the case require it, consult Industrial Committees in States or State Governments/Durbars. The recommendations should be submitted to Government through the Industrial Adviser.

III. A preliminary note containing factual information about the industry was prepared by the Secretary and was circulated amongst the members of the Panel before the first meeting.

IV. The Panel met on the following dates :—

(*a*) First meeting held on the 21st August 1945 at New Delhi.

(*b*) Second meeting held on the 27th September 1945 at New Delhi.

(*c*) Third meeting held on 26th and 27th March 1946 at New Delhi.

(*d*) Fourth meeting held on the 22nd April 1946 at New Delhi.

(*e*) Fifth meeting held on the 16th May 1946 at Bombay.

(*f*) Joint meeting with representatives of Provincial and State Governments and their Industries Committees held on the 13th July 1946 at New Delhi.

V. The Panel is greatly obliged to Col. Joynes of the Clothing Directorate, D.G. Supply, New Delhi and the Provincial Directors of Industries (to whom questionnaires were sent from time to time) for their willing help and valued advice.

VI. Grateful thanks of the Panel are also due to the Chairman for his able guidance at the meetings and for his keen interest in the work of the Panel.

VII. In the end the Panel wishes to place on record its warm appreciation of the valuable services rendered by the Secretary, Mr. A. S. Bhatnagar. His ability, knowledge and hard work have greatly facilitated the work of the Panel.

READY-MADE CLOTHING INDUSTRY

Growth of the industry.—Unlike some other countries where the industry on ready made clothing is well established and run on systematic lines, the industry hardly existed in India before the war. Prior to the 1st World War, there were two permanent Army Clothing Factories at Alipore and Madras with a combined monthly output of about 40,000 garments. In order to meet the greatly increased demand for army clothing during that War about 18 more temporary factories were started, but by 1931 only one factory remained in existence namely the Shahjahanpur factory with a monthly output of some 75,000 garments.

2. At the outbreak of the present hostilities there were also two comparatively small clothing factories at Moghalpura (Lahore) and Perambur (Madras) owned by the North Western Railway and the Madras and South Mahratta Railway respectively to meet their own requirements. There were also a few firms in the larger cities producing readymade garments on machines. Some manufacturers in Calcutta, Bombay and Madras had developed an export trade in clothing with Burma, South Africa and the Far East, but generally speaking the industry did not cater largely for the civilian market and the demand for clothing the civilian population in India was met by bazar durzies.

3. The reason for the non-establishment of the ready-made clothing industry in the pre-war period is not far to seek. India is a vast continent and on account of the varying climate, customs and tastes of the different areas, there is lack of homogeneity in clothing. It was therefore difficult to make the production of clothes to specifications a commercial success. Accordingly the production of clothing for the civilian population was not considered a profitable and economic proposition so far.

4. With the outbreak of this World War, the demand for military clothing again increased considerably, and was met by the Supply department by an all-round expansion of the industry. Not only was the Shahjahanpur factory expanded, but several new factories were also established for the production of military clothing and parachutes. There were during this War nine clothing factories at Shahjahanpur, Lahore, Madras, Calcutta, Agra, Sialkot, Delhi, Secunderabad and Bombay and three parachute factories at Lahore, Sialkot and Cawnpore. Except the factory at Lahore, which is owned by the North Western Railway, the remaining are owned by the Government of India. The Shahjahanpur factory, the Railway factory at Lahore and the three parachute factories at Cawnpore, Lahore and Sialkot produce tailored articles *viz.*, uniforms of all types; the rest confine their activities to cutting only and make over cut garments to contractors for fabrication. The parachute factories concentrate on the production of parachutes.

5. The total output of clothing for the year 1942-43 was about 100 million garments as against 900,000 garments which was the peace time yearly output of the Shahjahanpur factory. The number of skilled, semi-skilled, unskilled and supervisory staff employed in the above factories was over 33,000 (App. I). In addition more than 200,000 workers were employed by the contractors

throughout the country. Details regarding sizes, terms of occupation etc., of the existing Ordnance Clothing Factories are given in App. II attached to this report.

6. During the year 1942-43, the Ordnance Clothing Factories used about 300 million yards of cloth valued at about Rs. 45 crores. The total output of the factories during this period was 100 million garments valued at about Rs. 50 crores. The total labour charges and over head expenses incurred during this period were Rs. 3·66 crores and Rs. 1 crore respectively.

7. With the cessation of hostilities, there is already a considerable drop in the demand for military clothing and unless measures to switch over to peace time requirements are kept in readiness, there will be unemployment besides loss of energy and labour expended in organising the industry to its present pitch. Lakhs of skilled and semi-skilled workers mostly tailors will be thrown out of employment. It is true that some of the skilled workmen who are not retained after the war will start on their own or work for big tailoring establishments. But due to competition arising out of the immediate dislocation they will be exploited and their wages drastically reduced. Besides this, the valuable experience gained, during this period, by the industry, particularly tailors, of working on mass scale production methods will also be lost. The Panel therefore feels that the establishment of the ready-made clothing industry is essential in the post-war period.

8. It is a well established fact that at least five to ten percent saving in cloth can be affected when the cloth is cut on mass scale by modern methods. The whole world is at present experiencing an acute textile shortage. The establishment of this industry, in the opinion of the Panel, will be warmly welcomed at the present time of acute cloth shortage.

9. *Post-war target.*—The Panel recommends that during the next five year period five readymade clothing factories should be established in the country. Each factory should have a minimum production capacity of 10,800 garments per day consisting of :—

Shirts & Kurtas	3,600
Trousers	3,600
Shorts & Pyjamas	3,600
Total ..	10,800

It is suggested that the proposed factories should increase their production annually by 25%.

10. The Panel is of the opinion that in the initial stages a minimum economic unit under Indian conditions will be one producing 10,800 garments per day.

11. Regarding types of products the Panel recommends that the ready-made clothing industry should in the beginning, only manufacture shirts, trousers and shorts for the urban markets and kurtas and pyjama

for the rural population. A start may however be made by meeting the requirements of the urban markets, where the tastes of the population are to a certain extent uniform. Besides this, a well organised readymade clothing industry can capture a major portion of the requirements of uniforms from various Provincial Government Departments, Railways, Posts & Telegraphs and other Central Government Departments.

12. *Future location of the industry.*—The Panel recommends that the proposed five factories can with advantage be located at the following places:

1. Madras. 2. Bombay. 3. Calcutta. 4. Delhi. 5. Jullundur.

These places have been specially recommended because the industry already exists there and the requisite technical personnel will be readily available. Besides, these are also important textile producing centres.

13. *Raw materials.*—The main raw material used by the industry is cloth. It is estimated that the proposed five factories will consume on an average about 4 million yards of cloth per month. The Panel therefore strongly recommends that the Government should arrange to allocate the required quota of cloth to this industry. It is hoped that in addition to the saving of about 2·5 million yards of cloth annually, the establishment of this industry will to a certain extent help to check the present black marketing in the textile trade.

14. In order to keep a check on the distribution of the products of this industry the Panel recommends that until abnormal conditions in textile trade prevail, the distribution and allocation of the readymade garments to the different parts of the country should be controlled by the Textile Commissioner to the Government of India.

15. *Ownership of Industry.*—Generally speaking, state ownership of industries is desirable either on grounds of national interest or because private capital is not forthcoming. The clothing industry does not appear to satisfy the former condition; nor is it likely to be confronted with lack of private capital. The Panel is therefore of the opinion that the development of the industry should be left to private enterprise. No foreign co-operation either in form of capital or management is considered necessary.

16. *Government assistance and controls.*—In order to stabilise the industry in the initial stages of its development, the Panel recommends that there should be state control over marketing and distribution of products, supply of materials, designs and specifications, prices and wages. In this connection the Panel is of the opinion that the Government should appoint a special officer with high technical qualifications and administrative experience to watch and guide the interests of the readymade clothing industry. This officer should have a small technical establishment under him, where technical problems of the industry such as designing, standardisation of products etc., are tackled. The Panel recommends that this establishment should be located in one of the centrally situated Ordnance Clothing Factories which are to be closed down. This establishment can be worked both as a model institution for meeting the requirements of uniform of the Central Government Deptts. and as a research station. This organisation should also serve to provide the industry with the

latest developments, in machinery and designing, taking place in other advanced countries of the world. A small advisory committee consisting of representatives of the trade should be constituted to guide the work of this organisation. The Panel is of the opinion that the suggested manner of Government assistance will create confidence in the public mind and help in the firm establishment of this small scale but important consumer goods industry which will play a great part in the better and economical clothing of the Indian masses. The Panel feels that with Government assistance it will be possible in due course, to transfer the work of the Ordnance clothing establishments to these ready made clothing factories.

17. The Panel feels that under the present conditions, the readymade clothing industry does not need any protection and will be able to stand on its own legs. The Panel however recommends that concessional railway freights should be allowed for the transport of cloth required for the industry and the ready made garments.

18. The Panel feels that the Provincial Governments should provide all facilities such as supply of electric power at concessional rates, acquisition of land, registration of companies etc. to the prospective industrialists who wish to start this industry.

19. *Capital goods requirements.*—The readymade clothing industry has under gone numerous improvements in foreign countries, particularly United States of America, during this war. The entire industry has been reorganised on systematic lines and all processes of manufacture have been completely mechanised. It is understood that in the United States of America, a shirt goes through 36 operations and a well tailored coat through 68. There are special machines for every job. Even the ironing of cuffs and collars etc., is done under special machines and by specially trained men.

20. The Panel is of the opinion that modern and up-to-date machines should be imported in India for this industry, although a start should be made with whatever equipment is available in the country. Advantage should be taken of the machines available in the Ordnance Clothing Factories which are being disposed off by the Government.

21. The Panel feels that as long as the present restrictions on dollar exchange prevail, it may not be an easy affair for the Indian industrialists to obtain supplies of modern machinery from the United States of America and therefore the Panel urges upon the Government the necessity of the immediate release of the necessary dollars required by the industry for import of capital goods.

22. The Panel strongly recommends that Government should provide all facilities to prospective buyers of ready made clothing machinery to visit U.K. and U.S.A. to select the proper machinery.

23. Calculating on the basis of prevailing quotations received by the Panel members, the Panel is of the opinion that capital goods worth about Rs. 35 lakhs will be required by the industry during the next five year period.

24. *Development of the industry on cottage industry basis.*—Regarding the development of the industry as a cottage industry, the Panel feels that the industry can only be made to pay if worked on modern mass scale production methods. It is however felt that encouragement should be given, to develop it on cottage industry scale in those areas where cheap labour and other facilities are available. It is understood that the industry around Calcutta is being profitably worked on cottage industry basis.

25. *Technical personnel.*—The need for having properly qualified technical personnel for the industry cannot be denied. At present there is an acute dearth of technicians in the country. The Panel recommends that at least twelve young Indians should be sent abroad every year by the Government for advanced technical training in the different branches of this industry during the next five year period. Mr. D. N. Khandke, a member of the Panel has, on his recent visit to the United States of America, made arrangements with the Thread and Needle School, New York, for the technical training of twelve Indian boys every year free of their tuition fees at the school. The Panel feels that the Government should take advantage of this offer.

26. A very large number of technical personnel for lower jobs such as tailors, supervisors etc., will be required by this industry. It is felt that advantage can be taken of the proposed establishment by the Government of a number of polytechnics in the country. The Panel strongly recommends that there should be separate sections in these polytechnics for the training of lower technical personnel for the readymade clothing industry.

27. The Panel feels that foreign manufacturers supplying plants in India should send their technical experts to erect and work the factories in the initial stages.

28. *Export trade.*—The Panel is of the opinion that the question of exporting readymade garments should be taken up at a later stage, when the crisis arising out of the present acute shortage of textiles is over. It is however strongly felt that in the event of India's exporting textiles during this period the Government should insist, as far as possible, on the export of ready-made garments in preference to textiles. This will not only result in an appreciable saving of cloth but will also go a long way in the firm establishment of this new industry.

Delhi.

Floor area 29,565 sq. ft.

Consists of the first floor of a godown rented from the Delhi Cloth & General Mills at Rs. 1,350 per month, subject to 3 months notice.

Possibility of post-war retention doubtful.

The following outside building is also in use :—

Kashmere Gate godown, 8,000 sq. ft. rented from Rai Bahadur Madho Pers had, Delhi, at Rs. 200 per month.

Could no doubt be retained after the war, if wanted.

Calcutta.

Floor area, 160,000 sq. ft.

Partly in buildings rented from the Port Commissioners at Rs. 3,900 per month partly in temporary construction put up by the Supply Department on land rented from the Port Commissioners.

Unlikely to be available for post-war retention.

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GOVERNMENT OF INDIA

DEPARTMENT OF INDUSTRIES AND SUPPLIES

Report

OF THE

PANEL ON GLASS INDUSTRY

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INTRODUCTION.

The Glass Panel was constituted by the Government of India, Department of Planning and Development, to recommend to the Government such steps as are considered necessary for the development of the Indian glass industry and particularly to lay down targets which should be reached within five years and also to recommend the measures to achieve these targets. The Panel was constituted of the following:—

Mr. I. D. Varshnei (Chairman),
Managing Agent, U.P. Glass Works, Ltd., Bahjoi, (U.P.).

Mr. S. P. Ogale. (Member).
Proprietor, Ogale Glass Works, Ltd., Ogalewadi, Satara (S.I.).

Mr. R. D. Chandorkar, (Member).
Managing Director, Vijay Glass Works, Mazagaon, Bombay.

Dr. A. Nadel, (Member),
Glass Technologist to the U.P. Government, Cawnpore.

Dr. Atma Ram (Member).
Officer-in-charge, Central Glass and Ceramic Research Institute, Jadavpore, 24, Perganas, Bengal.

Mr. D. N. Sen, (Member).
Managing Director, New India Glass Works, Ltd., Calcutta.

Mr. Sridhar, (Member).
Proprietor, Messrs. Bishambar Dayal Shriniwas, Bangle Manufacturers, Firozabad (U.P.).

At a later stage Mr. K. C. Roy, Manager, The Bengal Electric Lamp Works, Ltd., Calcutta, was co-opted as a member of the Panel.

2. Mr. S. Datta was appointed as the Secretary. After his death, Mr. A. K. Datta was appointed to act as Secretary to the Panel.

3. The Panel was given a General Directive to aid its deliberations. The Panel has regarded this more as indicating the several aspects of the industry on which it should particularly express its opinion, rather than as completely limiting its scope of work.

4. In order to assist the Panel to formulate its recommendations, the Secretary, late Mr. Datta prepared a comprehensive factual note surveying the present position of the industry. Two questionnaires were issued in order to elicit the opinion of the manufacturers, dealers, consumers and other relevant parties. With a few exceptions, the response to the questionnaires has been generally good. The Panel held a number of meetings at important centres connected with the industry and invited representatives of industry, importers and Government departments for oral evidence, notes and discussions. Meetings were held at the following places:—

1. Delhi—23rd April, 1945.
2. Bombay—21st to 25th August, 1945.
3. Calcutta—12th to 15th November, 1945.
4. Firozabad and Delhi—7th to 9th January, 1946.
5. Delhi—29th and 30th April, 1946.

6. Delhi—19th August, 1946.

7. Delhi—1st November, 1946.

5. The Panel visited some factories and arranged discussions which have been very helpful to it in formulating its recommendations and confirming its findings.

6. The report is divided into two parts. Part I deals with the present position of the industry and other important aspects relating to its early development, organisation, location, imports, present production, causes of backwardness and so on. In Part II, the Panel makes recommendations with respect to targets of production, scope of development and other important aspects and records its replies to the points raised in the General Directive.

7. At the outset, the Panel records that during the enquiry, it has been constantly impressed by the fact that the manufacturers have invariably raised the question of the existing system of control of raw materials and their distribution, which they regard as one of the chief impediments in the way of improving the quality of production and of development of the industry. In the report, however, the Panel has assumed that these wartime measures will cease to exist and handicap the industry as during the war. The Panel believes that such an assumption is essential if we are to make plans for the development of the industry.

8. The Panel expresses its appreciation of the sustained and sincere efforts made by the late Mr. Datta for the success of this work. It is most unfortunate that his premature death denied the Panel of his valuable services at the time of drafting the report. Another severe loss from which the work of the Panel has suffered, has been the premature death of Mr. K. C. Roy, who was mainly responsible for most of the information supplied to the Panel on the electric bulb industry. The Panel also places on record its appreciation of the valuable services rendered by the new Secretary, Mr. A. K. Datta, in the reporting and concluding stage of the Panel's work. The Panel also wishes to acknowledge the help and co-operation which it has generally received from various parties in the course of its work. But it is difficult to mention the various parties here individually.

9. The Panel now begs to submit the following report to the Government of India through the Industrial Adviser.

(Sd.) I. D. Varshnei, (Chairman).
S. P. Ogale.
R. D. Chandorkar.
D. N. Sen.
Sridhar.
Atma Ram.
*A. Nadel.

A. K. Datta.
SECRETARY.

*Dr. Nadel was out of India at the time of final signature.

PART I.

EARLY DEVELOPMENT OF THE INDUSTRY.

10. It will be useful to start the Report with a short historical background of the development of the glass industry in India and the hard and continuous struggles which it faced in its early pioneering days. Glass manufacture in India on modern lines dates from the 90's of the last century when a bottle factory was started at Jhelum by the Murree Brewery with the help of a German expert. This venture was short-lived but it was followed by the starting of a number of other glass factories which were set up with the help of foreign technical experts. All these scattered attempts to start the glass industry in India, however, did not lead to the establishment of the industry on a solid and permanent basis. In fact, it has been estimated that over half a crore of rupees had been sunk and lost in these early attempts. With the outbreak of Great War I, however, imports from the European countries were cut off and thus a powerful impetus was imparted to the glass industry in India. The older units increased their output and new factories were started to take advantage of the war situation. Nevertheless, apart from bangles, in spite of best efforts, domestic production could meet only a small part of our total requirements and that again only in respect of ordinary blown-ware and some pressed ware. Simultaneously with the expansion of the industry in India, again, Japan which was steadily building up a well-organised glass industry based on mass production methods, seized the opportunity and captured a very substantial part of the market in India where it had almost no foothold before the war.

PROGRESS IN FOREIGN COUNTRIES.

11. In order to analyse clearly the causes of stagnation in the Indian glass industry, it will be profitable to see how this industry developed in other countries during and after Great War I. The condition of the glass industry in some of the European countries at that time was far from satisfactory. For instance, in England a considerable portion of her requirements, particularly in regard to optical and scientific glassware, was supplied principally by Germany and Austria which were at that time sufficiently advanced in the technique of glass manufacture. Two of the important developments during the inter-war period which materially influenced the growth of the industry in these foreign countries were:

(a) the organised application of scientific methods in the industry; and

(b) the increasing interest taken by the State in developing and fostering the industry.

It was during this period that the Department of Glass Technology was started under Professor W. E. S. Turner of Sheffield, which has been responsible for much of the great technical development in this industry. Simultaneously, the glass industry was being increasingly mechanised, the wartime shortage of labour having given a stimulus to the process. As a result, the entire character of the industry underwent a fundamental change. In this process of progressive mechanisation, America contributed very largely. The introduction of machines had a very great influence on every branch of glass manufacture, such as the type and size of furnace, the kind of fuel used, the type of raw materials, etc. It also altered the locational factors of the industry inasmuch as it was no longer absolutely essential to locate factories in the areas guaranteeing the availability of skilled glass workers. Again, due to the difficulties which the Government experienced during the war while the normal sources of supply of

vital and strategic glassware were cut off, the Government realised as never before the importance of actively developing this industry which was essential alike in peace and war. The State came forward to help the industry by giving it protection against unfair foreign competition in the form of tariff, subsidies, etc., and by financially and otherwise assisting in the establishment of technological institutions, research associations and industrial organisations on sound lines.

CONDITION IN INDIA.

12. In contrast, the circumstances which the Indian industry had to face were very difficult and adverse. Unlike that in other advanced countries, the Government did not come forward to assist the industry in spite of clear warnings. As late as 1931, after several representations from the glass industry since 1927, the Government referred its case for protection to the Tariff Board. The Board critically examined the different aspects of the glass industry and recommended the granting of protection and the establishment of a Government technological institution for helping the industry. The Government, however, turned down these proposals mainly on technical grounds. The case for the State coming forward to aid the industry has been very succinctly put by Sir A. Chatterton in the *Indian Munitions Handbook* thus:—

"The Glass industry has come to stay but without aid from the state, it is likely to make very slow progress in the future".

The Industrial Commission (1916) also stated that 'to establish a tariff and then to trust to private efforts is not likely to be productive of satisfactory results. Clearly, the State should take the lead, employ experts and place them in charge of practical works'. Unfortunately in India the State has been lagging in appreciating its responsibilities for helping the development of this important industry.

13. So far in regard to the patronage of the State. With regard to technical development also, we find that the Indian industry has been sadly lagging behind. As early as 1908 the Paisa Fund Glass Works training centre was established with the help of Mr. I. D. Varshnei who had received foreign training in glass technology, for teaching students in the practical art of glass manufacture. The industry, however, is established partly on the basis of cottage industry and partly on that of large scale industry. The size of the average factory is not very large and the number of factories with capital exceeding a few lakhs, is comparatively very small. During the war, there has been some tendency on the part of some financiers to come into the glass bangle industry. Although the workers have been derived mostly from the local artisan class, the management has in some cases been in the hands of financiers. The industry, again, is often run like a family concern by people who learnt the art of glass manufacture and themselves became in many cases the organisers *cum* technicians. Many of the well-known factories such as the Ogale Glass Works, Vijay Glass Works, etc., are like this. With the outbreak of the war, enterprise and capital from outside flowed into the industry and today while some of the factories are being run as proprietory concerns, others are run as limited companies on the managing agency system. The glass industry in this country thus represents diverse types of industrial organisation, varying from cottage industry to large scale units controlled both by proprietory and managing agency systems. Recently, there has been another healthy trend, viz., the establishment of a number of factories, some of them of appreciable size, in the Indian States.

TYPES OF ARTICLES PRODUCED.

14. The types of articles at present produced by the Indian Glass Industry can be classified under the following heads:—

(1) Bangles.

(2) Hollow-ware, including lamp-ware and table-ware.

(3) Bottle-ware.

(4) Sheet glass.

(5) Pressed-ware and fancy goods.

(6) Other varieties including scientific glass-ware, rods, test tubes, acid carboys, thermoflasks, glass shells for electric bulbs, etc.

The following review summarises the position of the several branches of the glass industry,

(1) *Bangles*:—

15. The bangle industry is one of the most developed branches of the Indian Glass Industry. It is concentrated in the small town of Firozabad where the entire population of nearly 40,000 is directly or indirectly connected with the bangle trade. The art of glass bangle making by hand as practised by the *Shishgars* of Firozabad has reached a fairly high state of efficiency through its century-old traditions. There has been an increasing use of locally made appliances for drawing the bangles in the form of spirals (varying from 100 to 200 circlets in a spiral). But here again, it is the skill of the workmen that largely contributes to the success of the operations. From the production of glass to the final stage of finished bangle, there are several processes which are seldom completed in the same factory and are usually done by different people skilled in the particular art. Some of the auxiliary materials (such as liquid gold and china glass) have been produced in this country by methods worked out at the laboratories of Industrial Research Bureau (now the Council of Scientific & Industrial Research). Bangles are produced in a variety of brilliant colours and are made by several processes. It is necessary to mention that the compositions that are used for producing the bulk glass for the bangles have mostly been evolved by the trial and error methods, after years of work. Those compositions are consequently regarded as trade secrets and are jealously guarded. In view of this and the great advance that has been made both in the composition and the technique of production of coloured glass, a great deal can be done for improving the production of coloured glasses for the manufacture of bangles.

16. The bangle industry has undergone great expansion during the war mainly on account of the stoppage of import from Japan and Czechoslovakia, the two principal exporters of glass bangles to India. The scarcity of chemicals and coal had been all the more acute in the case of this industry, since it was classified as an industry not associated with war efforts. The Glass Industrial Syndicate, Firozabad, estimates the total daily output to be about 80 tons a day valued at nearly Rs. 1,40,000, or an annual production of about 18,000 tons valued at over Rs. 3 crores. The growth in the number of factories and volume of production during the war years shows that in spite of a heavy increase in the cost of fuel, chemicals and labour and other wartime difficulties, the Firozabad bangle industry has been able to work on a satisfactory margin of profit. Considering the total amount of glass produced in the bangle industry, the improvement in the construction of furnaces for producing even the bulk glass has not, however, been noticeable. It is necessary only to add that

the bangle industry, both in its operation and in its organisation, differs considerably from other branches of the industry and deserves special considerations.

(2) *Hollow-ware* :—

17. The production of hollow-ware like tumblers, hurricane globes, lamps, chimneys, jugs, etc., is now carried on on a fairly large scale and the indigenous industry employing mechanical methods has been able to cope with the entire growing demands of the domestic market. The importation of these articles had almost entirely stopped during the war years. Even before the outbreak of the war, the Indian made hurricane lantern globes could compete effectively with the standard imported articles. In fact, from the oral evidences given before the Panel by several dealers, it has been established that the Indian made hurricane globes were actually being sold in India under some well-known foreign trade names. Even blown articles such as tumblers have been produced in quite large numbers and the products of some of the factories can stand comparison with the standard imported articles. Judging from the experience gained by the Indian manufacturers in the production of hollow-ware articles over more than three decades and from their ability to meet the war-time demands, it is reasonable to expect that the Indian factories will be able to cope with the entire demand of the internal market provided the finish of the articles is further improved—a consideration which is a determining factor in ensuring marketability. Mechanisation has not, however, yet made much progress in the industry.

(3) *Bottle-ware* :—

18. In every country the production of glass containers constitutes a very substantial part of the total production of all glasswares. In India before the present war, however, progress in this line, considering the requirements of the country, had been rather meagre. The indigenous articles could not compete with the imported products on account of their poor finish and quality, irregular capacity and in some cases low chemical or mechanical resistance which made them unsuitable for use by chemical manufacturers and Excise Departments. The production of bottles during the war has increased several fold and a number of factories of fairly big sizes have been started in different parts of the country. In a majority of the factories, bottles of various sizes and types are now made by hand-operated machines working on tank furnaces with a capacity varying from 1 to 15 tons. Annealing of the bottles is done in annealing kilns of the old pattern but in some new bottle factories equipped with tank furnaces, some automatic machines and annealing lehrs have been recently set up. Although there are no reliable estimates of the total quantity of bottles manufactured in the country, it appears from the answers to the questionnaires and the evidences of important producers, dealers and consumers that to-day enough bottles are made in Indian factories to meet the entire demand of the Indian market. Fancy bottles required particularly in the chemical and perfumery trade have also been produced but they have not yet attained the standards of imported articles. To some extent this may have been due to the non-availability during the war of important chemicals of right quality for such types of glassware. Nevertheless, it has to be admitted that a great deal of effort is needed to produce fancy bottles of the requisite standards before one can expect them to meet the Indian requirements which are growing in view of the increased production of perfumery and toilet articles in India.

(4) *Sheet Glass*:—

19. Before the War sheet glass was manufactured only in one factory in India (The U.P. Glass Works, Ltd., Bahjoi). During the war, the demand for sheet glass greatly increased and two more sheet glass factories were started to meet the increased demand, *viz.*, the Seraikella Glass Works, Ltd., at Kandra in Seraikella State near Jamshedpur and the Sodepur Glass Works, Ltd., at Sodepur, Bengal. All the three factories work on the Fourcault process using regenerative tanks. According to the figures collected from these factories, the total annual production of glass sheets is now about 13 million square feet and the total rated production capacity is 20 million square feet. The production capacity of these factories is being increased considerably and it is expected that it would soon reach the figure of 30 million square feet. Before the outbreak of the war, the total import of sheet and plate glass was nearly 25 million square feet, including figured and plate glass. The figures for figured and plate glass are not shown separately in official statistics but it is estimated that they amounted to approximately 3.4 million square feet. The total consumption of sheet glass in India was therefore 22 million square feet of import *plus* the output of the U.P. Glass Works of 6 million square feet, that is to say, a total of 28 million square feet.

(5) *Pressed-ware*:—

20. A small quantity of pressed-ware consisting chiefly of small dishes, jars, inkstands, plates, paper weights and tiles, etc., is produced in the country mainly by hand process. The total production of pressed-ware is very small and the quality leaves much to be desired.

(6) *Beads and False Pearls*:—

21. Beads and false pearls constituted a very big item of import of glass articles in India before the war. Crude varieties of beads known as cattle beads are produced as a cottage industry in a few centres in northern U.P. A training centre was started at Benares by the Glass Technology Section of the Department of Industries (U.P.) for training workers in the manufacture of beads. Some of the trainees later on set up small and independent working units; the U.P. Government granted them some financial assistance in setting up such units. Present production which is mainly confined to U.P. is still very small and is inadequate to meet the total requirements of the country.

(7) *Scientific Glassware*:—

22. The production of scientific glassware is an important although an entirely new development in our country. With the outbreak of the war and the difficulty of importation due to shipping difficulties and also the increased requirements of the exporting countries, there was an acute shortage of scientific glassware in India. Several factories which were not previously working in these lines started the manufacture of scientific glassware to meet the urgent requirements of the Indian market and some of them have already succeeded in putting on the market good and satisfactory articles. Considerable experience in this line has been gained by the Indian manufacturers during the war, but a great deal of improvement in quality and precision would be required before the industry can establish itself on a sound footing.

(8) *Optical Glass*:—

23. Optical and scientific instruments have been manufactured at the Mathematical Instruments Office, Calcutta, for long but until recently, they were mainly manufactured in small quantity or as individual instru-

ments to meet special requirements. After the outbreak of the war, the requirements of the Master General of Ordnance increased enormously and in 1941 manufacture of optical instruments in much greater volume was undertaken in India, under the direction of the Director General, Munition Production (Ordnance Factories Division). In addition to the capacity existing at the M.I.O., a new factory was erected at Dehra Dun to meet the requirements of large production of optical and scientific instruments. These two factories manufactured a large range of optical instruments during the last five years, all from imported blank but not from raw material. It is understood that certain commercial firms have now also established manufacture of optical instruments other than those of an exacting nature of high degree of accuracy. The production of optical glass and optical instruments has many aspect peculiar to its own. Glass of the highest quality is used. The problem of the optical glass industry is not entirely that of glass production but has a great deal to do with the manufacture of scientific instruments.

(9) *Glass shells for electric lamps*:—

24. The manufacture of glass shells for electric lamps is a recent development in India. Before the War, the Indian electric lamp manufacturers had to import all the glass shells required for the manufacture of bulbs. The Bengal Electric Lamp Works, Ltd., started production on a small scale in 1938 and until 1942 they were the only firm producing glass shells in India but they themselves consumed their entire output. When imports were curtailed, the electric lamp manufacturers found it difficult to obtain glass shells from abroad. At the instance of the Supply Department, the production of glass shells was, therefore, developed in the U.P. by Kaycee Glass Works Ltd., and the Ganga Glass Works, Ltd., and in Calcutta by Shree Govinddeo Glass Works, Ltd., Shree Hanuman Glass Works, Ltd., and the New Indian Glass Works, Ltd. Later on two other firms in Calcutta, *viz.*, the Electric Lamp Manufactures (India), Ltd., and Messrs. Calcutta Glass and Silicate Works, Ltd., were started in 1945 to manufacture glass shells. It was estimated that in 1945 the production of glass shells reached the figure of 10 millions. The development of this branch of the glass industry has made the Indian electric lamp manufacturers largely independent of foreign imports in respect of glass shells. The method of production, however, is not dissimilar to that of the mouth blown ware. Annealing of the shell is carried on in specially designed annealing lehrs. The composition of glass, however, varies from factory to factory.

PRESENT LEVEL OF PRODUCTION.

25. In the absence of proper data, it is very difficult to estimate with any degree of accuracy, the present output of glass and glass-ware in India, as well as the production capacity of the glass factories. The Indian Tariff Board was confronted with the same difficulty and all estimates so far made, have been based on the estimated total capacity of the works and the assumption of the number of working days in the year. Recently an attempt was made by the Director General of Commercial Intelligence and Statistics to publish monthly statistics of production of glass factories in India. Accordingly he sought the co-operation of the Provincial Departments of Industries and glass manufacturers, but after a few months, the project had to be abandoned "on account of the lack of co-operation on the part of glass manufacturers in India". The is certainly very regrettable, because the maintenance of proper statistics is as much in the interest of glass manufacturers as of the Government Departments.

The Panel feels that now with the organisation of the all-India Glass Manufacturers' Fedration which represents the bulk of the glass factories in India, it should be possible to take up this work again.

26. With a view to collecting more reliable and accurate data, a questionnaire was issued by the Panel, but the replies from all the factories have not been received yet and it is quite possible that some of the factories are unwilling to disclose their actual production figures and some may have supplied figures of the capacity of the furnaces rather than of actual production. When the Indian Tariff Board commenced their enquiries in 1931, they estimated the value of indigenous manufacture of various types of glassware as follows:—

	Rs.
Bangles	1,15,00,000
Bottle-ware	6,50,000
Lamp-ware	16,00,000
Sheet glass	2,50,000
Total ..	1,40,00,000

Later estimates show an appreciable increase in the output of the different varieties of glassware (other than bangles) over the estimates of the Tariff Board in 1931. Mr. Dixon estimated in 1935 the value of blown glassware produced in India as Rs. 36.5 lakhs per annum. But the Glass Technologist to the U.P. Government estimated the total value of pre-war production of glass and glassware in India as Rs. 120 lakhs per annum of which glassware other than bangles accounted for Rs. 40 lakhs. Dr. P. J. Thomas in his report put the value of annual production immediately before the War at Rs. 200 lakhs. This production met the bulk of the Indian requirements for glass bangles, but met only 30 to 40 per cent of the requirements of glassware other than bangles consumed in the country.

27. The value of production in terms of money would, however, be misleading unless we can compare the actual tonnage of production during different periods. The Glass Industrial Syndicate of Firozabad estimated that the daily production of glass bangles is about 80 tons valued at Rs. 1,30,000. Making allowance of 25% on 300 working days per annum, the total production of the bangle industry alone thus amounts to at least 18,000 tons valued at Rs. 3 crores. Another way of estimating the tonnage of production would be by way of the known amount of soda ash required for the glass factories, which had been released to the industry by the Government during the War. Assuming that the glass produced in the Indian factories contains on an average 18% of sodium oxide and that all the soda ash released has been used in the production of glass, the total quantity of glass melted may be taken to be about 70,000 tons (the quantity of soda ash released during 1944 being 21,000 tons). It is true that some of the factories have utilised quite a large amount of cullet for making glass articles and a certain amount of soda ash may have been obtained by the glass industry from sources not covered by the release. Moreover allowance must be made for wastage and breakage. Taking all these factors into consideration, the Panel is inclined to believe that the total production of glass articles, in terms of tonnage, was not more than 1,00,000 tons. From the answers to the questionnaire issued by the Panel, the total quantity of glass melted in glass furnaces could be put at 150,000 tons. This is probably an over-estimate. At the same time, it should be mentioned that on account of the great transport difficulties experienced by the glass industry during the War, the industry could not get enough raw materials and was probably working under capacity for some time.

REVIEW OF TRADE.

28. Statistical data relating to the trade of India in respect of glassware are adduced in Statements No. 2 and 3 given in the appendix. It would be seen that in ten years Japan's quota had risen from nearly 30 to 50% of our imports, a most remarkable increase being in the case of bangles, bottleware, scientific glassware and sheets and plates. It would also appear from the tables that after Great War I, Japan succeeded in capturing a good part of our market and obtained a firm foot-hold here. The peak imports were in the year 1920 (more than Rs. 3 crores) and in spite of the encouragement that the domestic industry received from the Swadeshi movement, the import of glass articles remained quite substantial amounting to about half of the total value of Indian requirements. Again in the case of certain items like plate glass, beads, false pearls, etc., almost the whole of the Indian requirements were met by import. India had also developed some export trade with some of the neighbouring countries such as Aden, Malaya, Iran, Ceylon, etc. During the recent War, when the major exporting countries were unable to supply the requirements of these neighbouring countries, India had an excellent opportunity of capturing this export market. However, on account of the non-availability of essential raw materials and shipping facilities the opportunity went grievously by default. If India is to capture the export market in glassware, particularly in the neighbouring countries, the question of freight and transport policy both by land and sea will have to be properly examined.

THE QUALITY OF PRODUCTION.

29. With a view to assessing correctly the quality and performance of the Indian made glass articles as compared with those of the imported glassware, one of the members of the Panel, Dr. Atma Ram had previously issued a questionnaire to elicit the opinion of big consumers such as chemical and pharmaceutical manufacturers, excise departments, brewers, medical institutions, railways, public works and health departments of the Governments, engineering firms, purchase and inspection authorities including testing departments of the Government and importers of glassware, etc., in the different Provinces and States. The replies received would be of considerable interest, particularly for planning the future of the industry. It is known that so far no arrangements have been made in India by any Government agency or producers for the regular testing and standardisation of the various types of glassware. Some of the common defects pointed out by the consumers are non-uniformity of shape and volume, varying wall thickness, lack of proper finish, comparatively poor annealing resulting in undue breakage in transport and storage, low thermal endurance and lack of brilliance. It has also been stated that there are some special defects as well, e.g., Winchester bottles made in India for the storage of acids are considered to be unsuitable due to the incorporation of arsenious oxide in the glass batch. Some of the defects are no doubt due to purely war-time exigencies such as shortage of proper chemicals, refractories and fuel, but other defects are also due to lack of proper technical control. In an industry in which mechanisation has progressed so little as yet and labourers are often moving away to other jobs attracted by higher wages, non-uniformity in production, as well as in the accuracy of capacity and dimensions has been accentuated.

30. Nevertheless, the burden of evidence collected from manufacturers, dealers, etc., has been that an organised effort is necessary on the part of Indian producers if Indian products are to compete successfully with imported glassware. Some of defects are both avoidable and unavoidable. During the War, the emphasis has been on quantity rather than on quality and the Indian products

have captured the home market only because imported articles have not been available at all., The replies as a whole do not indicate any particular prejudice against Indian made articles, provided comparable quality and performance can be ensured., The prejudice, if at all, is due to the lack of uniformity in production and in quality of the articles produced. That is to say, it is a case of preferential consideration of quality of articles rather than an express prejudice against Indian made goods as such. There are certain classes of articles however, such as bottles, particularly those required to stand pressures (mineral water bottles, excise bottles etc.,) scientific glassware of quality and precision and fancy glass articles which will continue to be imported unless the quality and performance of the Indian products can be improved to a standard comparable with that of the imported articles.

CONDITION OF GLASS FURNACES IN INDIA.

31. High temperature furnaces constitute a most important equipment of glass factories. Within the last few years there has been a growing tendency among glass factories to change over from pot furnaces to tank furnaces., This has been due to a realisation of the limitations and wastefulness of the Japanese pot furnaces and the advantages of adopting the improved technique obtaining in other countries. A reduction in fuel cost was considered particularly important in a comparatively depressed market such as obtained during the years preceding the war. The trend towards changing over to tank furnaces received further impetus immediately after the outbreak of the War with Japan when it became difficult to get pots from that country. Many of the tank furnaces, however, are direct-fired and so suffer from practically all the defects of the older pot furnaces except that the pot has been eliminated and some slight economy of fuel effected. A number of regenerative and recuperative furnaces have been built in some factories but in regenerative furnaces of indigenous designs, some of the units suffer from a great many drawbacks, e.g., use of small refractory blocks in building the basin of the tank furnaces, use of fire bricks instead of silica bricks in building furnace crowns, ineffective heat insulation, and so on. Similarly, in one or two cases, the annealing lehrs were so badly built that they gave results worse than those obtained with ordinary annealing chambers. The following statement clearly shows the unsatisfactory position with regard to furnaces.

Furnaces.

Total number of glass factories	174
Factories having regenerative or recuperative furnaces	24 (13.8%)
Factories out of the above 24 which have efficient and well designed furnaces	10 (5.7%)

Annealing Lehrs.

Number of factories making hollow-ware ..	125
Direct-fired pan lehrs	10 (8.0%)
Gas fired or oil fired lehrs with automatic conveyers	5 (4%)

The use of incorrect type of fuel has also in some cases resulted in bad performance of otherwise good units. Further, better furnaces require trained personnel to keep them in good running order and in this respect, too, difficulty has been experienced. Some attempts have been made in the past to build with Government aid demonstrational furnaces of improved types in a few factories in U.P. A few other factories in Bengal acting on their own initiative have installed "Teisen" recuperative furnaces. In some other cases still, good

regenerative units have been built by the factories through their own efforts. Thus, it would be seen that the progress achieved so far is very meagre and it is only by organised and intensive efforts coupled with proper supply of raw materials and transport facilities that the position can be improved satisfactorily. Recently some efforts have been made with considerable success to use fuel oil in place of steam coal. Fuel oil gives better control of temperature and is also more economical in terms of cost of labour, storage room and furnace. The use of fuel oil should be encouraged not only because it is a by-product in the manufacture of petrol but also in the interest of conservation of high grade coal. The price of furnace oil should be so regulated that the price of crude oil is not higher than double the price of coal, ton for ton.

CAUSES OF THE BACKWARD STATE OF THE INDUSTRY.

32. The Panel has already referred to the factors which have contributed to the backwardness of the glass industry in India as against the glass industry in some other countries. In other countries with a flourishing glass industry, there has been an organised effort to incorporate scientific and technical improvements in the glass industry and secondly, the State itself has come forward to foster and encourage the industry by suitable measures. In India, on the other hand, the manufacturers have not been able to take advantage of the technical developments which have been made in other countries and the State has also not realised adequately its responsibilities towards the development of this important industry.. Broadly speaking the causes of the backward state of the glass industry in India may be summarised as follows:

(i) Uneconomic conditions created by dumping and unfair competition by well-established foreign industries and the failure of the State to extend tariff protection on an adequate scale to the struggling Indian industries.

(ii) Lack of proper and sound internal organisation of the industry which has grown up partly on a cottage and partly on a large scale basis.

(iii) Low technical standards and slow progress in technical developments both as a result of severe competition from abroad and due to the absence of technological institutions.

(iv) Want of proper supply of raw materials, fuel, refractories and transport facilities.

Part II.

THE GLASS INDUSTRY AS A KEY INDUSTRY.

33. As a result of intensive application of scientific methods to industrial production, glass which was once only an article of artistic taste, has emerged as a material of wide utility and strategic importance, which can be processed in a variety of ways to meet the increasing requirements of both war and peace. It is marvellous to contemplate that such a fragile material like glass could be made into such varying types of articles, ranging from fabric to blades and flanges of centrifugal pumps. Indeed, glass is to-day one of the triumvirate of modern industrial materials—the other two being steel and rubber—which are largely responsible for the progress of science and technology. Many scientific instruments and apparatuses of the most complex kind depend on the glass industry. Its optical characteristics, resistance to corrosive materials, non-combustibility and insulating properties, make it a versatile material in modern technology, while its cleanliness and transparency make it a very suitable material for household wares and now even for furniture and fabrics. Modern housing ideas, particularly with emphasis on sanitation, lean increasingly on the use of glass as building material, while chemical, pharmaceutical, fermentation and other industries have to depend for a wide variety of containers, essentially on glass. In the electrical industry also glass with its insulating properties plays an important role. Again, there is the industrial problem created by the progressive exhaustion of irreplaceable metal resources, particularly of key non-ferrous metals like copper, zinc, tin and lead. Here glass along with plastics, which are made from resources which can be classed as almost inexhaustible, may be expected to replace metals in a variety of uses, and thus help in the conservation of metallic resources. The production of toughened glass, a material possessing tensile strength, has further extended its field of utility. From all these considerations, the versatility of glass as a key material of wide application is easily established. In the optical industry particularly which is of such strategic importance in science and war, glass occupies a key position. Glass is now universally regarded as a key material. It is unfortunate therefore that whereas other countries have made such rapid progress in making glass a key industry, conditions in India have remained comparatively stagnant.

POST-WAR TARGETS.

34. Seen from a wide perspective, the glass industry thus is bound to occupy in the long run, a very important place in our industrial structure. What is more relevant here, however, is to lay down roughly the scope and extent of development of the glass industry in the immediate future, that is to say, during the next five years. As already stated, the output of the glass industry in India has greatly increased during the war and in several lines the present productive capacity of the glass factories to-day is sufficient to meet the total requirements of the country at the existing level of consumption provided, of course, that the manufacturers are assured of adequate transport facilities and supplies of the necessary raw materials and coal and the glass manufacturers concentrate on improving the quality of production and undertake proper grading, standardisation and marketing of the products. The Panel thinks that if India is to occupy a place in the industrial world, the aim should be to reach at least the level attained by the glass industries in the other countries, in the course of the next ten years. This will undoubtedly call for a great deal of effort and organisation but it should not be difficult to attain this high level.

35. In laying down the targets, the Panel has proceeded on the following basis:—

(i) In respect of articles which are now produced in this country but whose supplies have to be partly supplemented by import, our aim should be to raise the scale of output to such a level and attain such a quality that the total requirements of the home market can be met wholly by domestic production;

(ii) In respect of articles which are not yet produced in this country, the aim should be to initiate their production without delay; and

(iii) During the war emphasis has been more on quantity than on quality. In the coming years more stress should be laid on attaining a standard of quality which could compare reasonably with similar articles from foreign countries.

36. On this basis, the Panel gives the following statement of targets of production during the first five years for the different sections of the glass industry together with a note on the Panel's recommendations in respect of each of these sections:—

STATEMENT OF TARGETS FOR THE FIRST 5 YEARS

Section	Pre-war production 1937-38	Pre-war Import 1937-1938	Pre-war total consumption	Target	Present production capacity
1. Bangles ...	Rs. 80 lakhs (12,000 tons)	Rs. 29·3 lakhs (3,000 tons)	Rs. 109·3 lakhs (15,000 tons)	19,800 tons.	18,000 tons.
2. Beads & false pearls.	...	Rs. 18·9 lakhs (4,2000 tons)	4,200 tons.	4,200 tons.	120 tons.
3. Bottles & Phials (a) .	Rs. 10 lakhs (20,000 tons)	Rs. 29·3 lakhs (60,000 tons.	Rs. 39·3 lakhs (80,000 tons.)	100,000 tons.	100,000 tons
4. Lampware ...	Rs. 20 lakhs (7,500 tons)	Rs. 6·9 lakhs (2,000 tons)	Rs. 26·9 lakhs (9,500 tons)	14,000 tons.	10,000 tons
5. Tableware ...	Rs. 8 lakhs (2,500 tons)	Rs. 6·0 lakhas (2,500 tons)	Rs. 14 lakhs (5,000 tons)	7,500 tons.	5,000 tons.
6. Pressedware	Rs. 2 lakhs (1,000 tons)	Rs. 5·0 lakhs (1,500 tons)	Rs. 7 lakhs (2,500 tons)	4,000 tons.	2,000 tons.
7. Sheet Glass (b)	6 million sq. ft.	22 million sq. ft.	28 million sq. ft.	42 million sq. ft	20 million sq. ft.
8. Plate & figured	...	3.4 million sq. ft.	3.4 million sq. ft.	4 million sq. ft.	...
9. Scientific glass apparatus (c)	Negligible	Rs. 1·9 lakhs	Rs. 1.9 lakhs	Rs. 10 lakhs with proper qualitity	...
10. Glass shells ...	...	...	...	25 million pieces.	14 million pieces.
11. Optical glass (d)	...	...	...	...	...

Notes:—

(a) Statistics of mineral water bottles and other bottles should be maintained separately.

(b) Statistics of pressed-ware as well as of sheet glass and plate should be maintained separately.

(c) Many of the scientific apparatuses made in India lack in precision. Therefore, the productive capacity is not set down.

(d) Statistics of optical glass could not be obtained ; hence the target could not be set.

All figures given in tonnage and within brackets, are estimates.

(1) *Bangles.*

37. The Panel considers that the production of bangles has reached a stage when our domestic output is sufficient to meet the post-war requirements of the country. In respect of some varieties of bangles, however, which have so far been exclusively imported, there is scope for development and an increase of 10 per cent in tonnage or 1,800 tons may be set down as the target for the first five years.

(2) *Beads and pearls* (see below).

(3) *Bottle-ware.*

38. The domestic production of bottles has increased several-fold to meet the increased war-time requirements and the Panel feels that the present productive capacity is sufficient to meet the entire requirements of our home market in the immediate future. But the quality of the bottles has to be improved very considerably if our products are to compete successfully with the imported articles.

(4) *Lamp-ware.*

39. During the war, on account of the switching over of lamp-ware producers to the production of bottles, the supply of lamp-ware diminished greatly but as this was accompanied by a shortage of kerosene, the pressure of effective demand was relieved to that extent. With the return of normal conditions, the use of kerosene lamps in the rural areas is likely to increase very considerably in spite of the spread of electrification. The target accordingly has been set at 14,000 tons as against the present production capacity of 10,000 tons per annum.

(5) and (6) *Table-ware and pressed-ware.*

40. During the war, there has been an acute scarcity of table-ware of all classes. The Panel anticipates a large increase in the demand for table-ware and pressed-ware in the immediate post-war period. This is because the use of glass table-ware has spread even to the rural areas. Particularly in view of the high price of metal articles which is likely to continue for some time, on account of competing demands for metal, the demand for glassware is likely to increase even further. The Panel, therefore, recommends that the target for the increase of production of table-ware should be set at nearly 50 percent over the tonnage of total consumption in pre-war years.

(7) *Sheet glass.*

41. As already stated, the total quantity of sheet glass produced by the three Indian factories, is about 13 million sq. ft. whereas their full production capacity is rated at about 20 million sq. ft. per annum. This capacity is being raised to 30 million sq. ft. soon. The Panel has set the post-war target during the first five-year period at 42 million sq. ft. on the assumption that we shall be able to meet the whole of the increased requirements of the home market without recourse to importation.

(8) *Plate glass* (see below).

(9) *Scientific glassware and apparatus.*

42. As already stated, the scientific glassware industry started during the war, has been able to meet a considerable part of the country's requirements mainly due to stoppage of imports. As more and more of scientific and educational institutions would be established in the post-war period, the Panel anticipates that the present demand would increase several-fold. The Panel, has therefore, set the target at Rs. 10 lakhs. But in view of the exacting require-

ments of this type of glassware, the quality and precision of the articles produced need considerable improvement and should be brought up to the level of imported articles. The maintenance of the uniformity of production is a sine qua non for this development; this again would be possible only if adequate supply of raw materials and chemicals of proper standards can be ensured.

(11) *Optical glass* (see below).

ESTABLISHMENT OF NEW INDUSTRIES.

(a) *Beads and false pearls.*

43. The consumption of beads and false pearls amounted to Rs. 18.5 lakhs in this country before the war and the whole of this was imported mainly, from Czechoslovakia and Japan. Due to the exigencies of the war, this import was completely stopped. Although bead making on a cottage scale has recently been started in India mainly by students trained at the Glass Technology Section of the U.P. Government, the output is yet too small to meet the country's requirements. The Panel recommends that this line of production should be taken up on an organised basis. The Panel is not in possession of the details of the different processes of manufacture in use in other countries, particularly in Japan, Czechoslovakia and Italy. But in order that the industry should be started and established as soon as possible, the Panel suggests that:—

(i) two batches of at least three technical men (one scientific worker and two practical workers already acquainted with the nature of the work) should be sent to Japan and Czechoslovakia respectively to study the various processes of bead making; and

(ii) arrangements should be made to bring a few Japanese and Czech bead makers to India, with those people on their return.

The Panel considers that such a procedure would be a more practical way than merely importing foreign experts to train the local workmen in this country. This will enable our technical men to see what is actually being done in these countries. Meanwhile, arrangements, both financial and organisational, for starting bead works should be completed, so that when these people return, they can find adequate scope for utilising their technical knowledge and experience effectively.

(b) *Plate glass and optical glass*:

44. These new lines should also be taken up during the first five-year period. The processes of manufacture of these articles are very exacting and complicated, and their manufacture also requires a large outlay of capital. The processes are covered under patents or under trade secrets and long established and standardised techniques of a few concerns. Optical glass manufacture also involves extreme precision of work. The total demand of optical glass is not at present very large in India but optical glass is an indispensible and strategic material and, weight for weight, optical glass is the highest priced of all glassware. The smallness of Indian requirements of optical glass has often been cited as an argument against starting the industry in India in the immediate future. The Panel completely rejects this view because the optical glass industry is a vital and key industry both in peace and war. The Panel strongly recommends the starting of this strategic industry without delay.

EXAMPLE OF CANADA.

45. The Panel is convinced that the normal method of laboratory experiments followed by commercial exploitation would not be a quick and practical way of establishing the optical glass industry whose production has reached

a high state of perfection and standardisation in other countries. In this context, it would be useful to cite the example of Canada. Canada did not have any optical glass industry before the war. But the Canadian Government decided to take immediate steps for the speedy production of optical glass. The co-operation of certain British firms was enlisted through the British Government. In this connection the following account given by Dr. W. M. Hampton, Physicist of Messrs. Chance Brothers & Co., Ltd., describing how the industry was established in Canada, is worthy of note:—

"A Government Company, Research Enterprises, Limited, was formed during 1940 to erect a factory in Toronto for the manufacture of various instruments, and in some cases the raw materials which were necessary for them. When it was decided, about October, 1940, to commence the manufacture of optical glass there, Colonel W. E. Phillips, the President of the Company, approached Chance Brothers & Co., Ltd., through the Canadian and British Governments, with the suggestion of co-operation. As a result of that approach, I visited Toronto in November, 1940, in order to ensure the most rapid development of the new undertaking. The result was that an arrangement was reached whereby the fullest information concerning the manufacturing technique was transferred to the Canadian factory, and certain physicists from Canada came to England and were trained in the art and technique of making optical glass. These physicists remained at our works for some two to three months and were attached to our own personnel, so that they had the fullest opportunity of learning all that we could teach them about the manufacture of optical glass. A number of other people were recruited in this country, some from the Canadian Forces here and some from our own staff, and were given a special intensive course before being sent to Canada for starting up the new process. Further, when manufacture began, one of our technicians went to Canada for some months in order to assist in overcoming the initial difficulties, so that the closest co-operation was maintained. When it is realised that in November, 1940, the optical glass plant consisted of merely the walls of what was to be a factory, and that the first melting was successfully made in June, 1941, and that by the end of 1941 a considerable number of meltings of first quality glass had been made, it will be realised that, owing very largely to the enthusiasm and drive of the Canadian executives, a very remarkable result has been achieved. There has throughout been the closest co-operation between the Canadians and ourselves and it can be said that there has been no serious hold-up or difficulty in transferring the manufacture from this country to that."

In a similar manner, Australia too has developed an optical glass industry within the short space of a few years during the war.

46. The above examples would clearly indicate what could be achieved in India also if the co-operation of foreign firms which are already established in the line, could be enlisted. The Panel recommends that the Government should immediately explore the possibility of establishing the manufacture of optical glass and optical instruments in India on the Canadian model and establish a company with the Government contributing half the capital. In view of the comparatively greater risks and speciality of manufacture in this line, it is doubtful if any commercial concern would be willing to come forward without Government participation and foreign co-operation on some such lines. It may be of interest to mention here that the existence of a number of good workers trained in the operation of grinding of optical glass pieces at the Mathematical Instruments Office, Calcutta, which maintains a good precision workshop, would be of considerable help in starting the industry in our country and the nucleus of the M.I.O. as well as the Central Glass and Ceramic Research Institute could be usefully utilised in this connection.

47. The Panel further recommends the adoption of similar means also in the establishment of the plate glass industry (including the manufacture of toughened or armour plate glass which is important for defence purposes) in case private parties are not willing to come forward.

TECHNICAL TRAINING.

48. The paucity of adequately trained technical personnel in the glass industry has long been recognised as one of the reasons why the glass industry has particularly lagged behind in technical progress. The first notable effort to fill up the lacuna was the establishment of the Paisa Fund Glass Training Centre at Talegaon in 1908. In 1937, the Benares Hindu University took the initiative and provided certain facilities for training in glass technology. Although, the standards were not fully comparable to those attained in foreign countries, these facilities were greatly appreciated. Its graduates are finding employment in factories on an increasing scale and some of them are now holding responsible positions. In order that this Institution may more adequately meet the increasing and exacting demands of the glass industry, the Panel recommends that the University should review the working of the Department, which may also provide a better co-ordination with the industry. Further, more ample funds, to which the Government should also contribute, should be made available to the Institution, so that the facilities afforded by it may be further widened in scope as an integral part of the provision of technical training in this country. The Central Glass and Ceramic Research Institute (vide para. 51) should, of course, be also suitably provided with sufficient funds to perform its important role in the development of the Indian Glass industry, by organising research as well as providing facilities for higher technical training.

FOREIGN TRAINING.

49. The well-established and standardised processes in the manufacture of many types of glass articles such as optical glass, chemical resistant glass, toughened glass, plate glass, etc., are comparatively unknown in India. It would be essential not only to bring foreign experts on a contractual basis to train our workers in India but also to send suitable Indian personnel for training abroad. Only those who already possess some practical experience and theoretical training in the particular branch of the industry, should be sent abroad for further training. The Government have recently sent a number of students for training in glass technology. This has been done without proper liaison with the industry with the result that the latter has been unable to make full use of their technical knowledge after their return. Again, glass technology is a very wide subject and when sending students abroad, it would be necessary to specify the particular branch in which training is sought. To expect one person to return as an all-round expert in glass technology would be an error. Further, arrangements should be made for giving the students some basic training in the particular subject, before they are sent abroad.

TRAINING OF OPERATIVES.

50. In order that the operatives in the glass industry may receive better training and may also know the practical methods adopted in foreign countries in the actual process of production, the Panel recommends that some foreign operatives should be brought over to this country. As a first and experimental measure, the Panel recommends that operatives of the following four types should be brought:—

(1) A foreman for operating semi-automatic machinery in the Blowing Department;

(2) an engineer working for maintenance and repair of semi-automatic machinery in the Blowing Department and also experienced in its repairs;

(3) a smelter for tank furnaces; and

(4) a foreman of the pressed-ware department.

These men should also be attached to the Central Glass and Ceramic Research Institute which is being started. A supervisory Committee consisting of a representative of the Institute and two technical men from the industry nominated by the all-India Glass Manufacturers' Federation should be appointed. They should be brought on a contractual basis, say, for a period of three years in the first instance and they should be selected by representatives of the Glass Manufacturers' Federation and the Central Glass and Ceramic Research Institute. These people should be brought over as operatives or technical personnel and should in no case be put in executive or administrative posts.

TECHNICAL INSTITUTIONS.

51. The Panel records its great satisfaction that the Council of Scientific and Industrial Research is establishing a Central Glass and Ceramic Research Institute at Calcutta for helping the development of the glass and ceramic industries in India. The establishment of this Institute is well under way and at this stage, the Panel does not think that it is in a position to say anything about the research grants and such other contributions. The functions which have been assigned to the Institute are of a very fundamental nature and the Panel only hopes that the Government would ensure that the Institute is suitably provided with ample funds, equipments and staff to discharge its important functions properly.

52. The Panel has also deliberated as to how the Provincial organisations dealing with glass should be related to the Central Institute without risk of unnecessary duplication of work and functions. The Panel recommends that the Provincial Departments should be affiliated to the Central Research Institute in the general policy and working though they remain autonomous in their own activities.

53. *Bangle industry*:—The Panel would also like to refer to the question of a specialised school and a laboratory for the bangle industry which is predominantly located at Firozabad. The bangle industry has technical problems peculiar to its own (including particularly automatic stone-cutting and polishing, etc.), and also constitutes, judged by value of output, about 70 per cent of the entire glass industry. The Panel is of opinion that it is important that a specialised State school like that at Haida, Steinschonau, Zelenzny Brod Gablonz or Turnov in Czechoslovakia be started at Firozabad with well experienced teachers trained over there and some experts brought over from there. It will be interesting to note that in Gablonz alone there were about 60 to 80 thousand glass workers employed as home workers in 1927 for Gablonz type of glass which includes fine varieties of bangles, beads, imitation precious stones, necklaces, watch chains and Bejoutrie. It would thus be seen that Firozabad is as important in India as Gablonz was in Czechoslovakia in 1927. The industry has considerably developed over there since but Firozabad has received very scanty help, if at all, from Government. The Panel considers that Firozabad is the proper place for the location of a laboratory for the glass industry. Although a laboratory has been located at Cawnpore for some time,

little useful purpose is being served there by it, and the Panel considers that in the best interests of the glass industry, the laboratory should be transferred to Firozabad. This view, however, is not endorsed by Dr. A. Nadel, who, unfortunately, could not attend the final meeting of the Panel in which this question was fully discussed.

CO-OPERATION WITH FOREIGN FIRMS.

54. In the recommendations relating to the development of the optical glass industry, the Panel has indicated a model of foreign technical co-operation which it would welcome in India also in the interest of the speedy development of the industry. There is at present practically, no foreign capital in the Indian glass industry and the Panel does not think that the industry has any need for foreign capital; all that is required is technical knowledge, technical personnel and facilities for training of Indian technicians on an adequate scale. The Panel does not think that it is possible to have the technicians trained in a particular art of manufacture without interesting the foreign firms in some form or the other. There can be several methods of doing this, e.g., by taking a certain process under licence and agreeing to make payments over a certain period, or by allowing a stipulated share in the profits. The Panel is of the opinion that the question of co-operation with foreign firms should be faced on a realistic basis and decided strictly in consonance with our wider national interests. The Panel, however, emphasises that the co-operation should not be made in such a manner and to such an extent that the Indian industry is converted into an appendage of foreign interests. The direction and control of policy should and must always remain in the final analysis in Indian hands and even when foreign experts have to be appointed, the key executive positions must be manned by Indian alone.

GOVERNMENT OWNERSHIP.

55. The Panel has given careful consideration to the question in the General Directive as to the extent to which the industry should be under Government ownership either on wider grounds of national interest or because private capital is unlikely to take it up. The Panel is of the opinion, on the basis of the evidences collected by it, that the glass industry should not be owned by the Government except to the extent and in the manner already indicated in the Panel's discussion on the establishment of the optical glass and plate glass industries. In the case of the optical glass industry, which is of vital importance in our economy not only from strictly industrial considerations but also from the point of view of the essential defence requirements of the country, its partial ownership by the Government would be justifiable. The more so, because private enterprise in this particular line is unlikely to come forward at this stage. Apart from this particular instance, however, the Panel does not think that there is any case for Government ownership in other sections of the glass industry.

LOCATION OF THE INDUSTRY.

56. During recent years, the problem of localisation of industry has attracted considerable attention. Broadly speaking, the three important locational factors are, availability of raw materials, nearness to the market and the availability of skilled labour in the particular area. In the case of the glass industry, the factor of nearness to the market is probably of greater determining influence than the nearness to raw materials. This is mainly due to the fragile nature of glass articles which does not bear so easily haulage over long distances. Moreover, glass articles

in the finished form are, weight for weight, much more voluminous than the raw materials, and have to pay much higher rates of railway freight than the raw materials. The success of many industries in the south and north-west of India far removed from the sources of raw materials and fuel is to be attributed to the importance of nearness to market as a locational factor.

57. During the war, when the essential aim has been to supply the increased requirements of the country at any cost, due regard could not always be given to the more permanent and stable locational factors of the industry. During enquiry, the Panel has noticed a tendency, natural enough, on the part of every Province and State to have every section of the industry located within its respective jurisdiction. Without making any specific reference, the Panel may add that in some cases this desire was not altogether well-founded. While the Panel is fully alive to the need of balanced and co-ordinated development of the resources of all the Provinces, it is strongly in favour of the formulation of a rational localisation policy which does not sacrifice the most economic production and efficient utilisation of our resources and transport facilities. While we must eschew narrow provincial feelings, at the same time, no Province should be allowed to have a virtual monopoly of any particular industry unless natural factors absolutely dictate such a dispensation. The State should exercise some control through a proper machinery on the establishment of factories by introducing some kind of licensing system, so that a rational localisation policy may be enforced. The need for such an intervention is exemplified by the case of the sugar industry. After the grant of protection to the industry, a large number of factories were established in the U.P., concentrated in a small area. Consequently, there ensued an unhealthy competition over the sugar-cane grown in the locality, throwing at the same time a great burden on the railways for handling cane for long distances. The situation became so serious that the U.P. Government had to intervene and introduce a zonal system. Another direction in which control may be of help would be to avoid the growth of a large number of factories specialising in the production of goods of only one type while there may be enough field for the manufacture of articles in other lines not yet adequately developed. This should not, however, imply grant of monopoly to some particular factory.

58. In the N.-W.F.P., and in Southern India, the glass industry is comparatively less developed. Manufacture of lamp-ware, table-ware, pressed-ware and sheet glass may very well be developed in these regions. In the N.-W.F.P. fuel oil is available near at hand, while other raw materials are suitably available in both the zones. Efforts should also be made to investigate the possibilities of the glass industry in Rajputana and Central India which may possess some advantages in regard to the glass industry. The Panel may also refer here to the case of the manufacture of sheet glass. The present factories are located in the northern belt. But in view of the demand from the southern regions, the Panel feels that at least one factory must be opened somewhere in the southern regions. Although the cost of production of sheet glass may be comparatively lower in the three existing factories located in the northern regions, the burden of increased freight on sheet glass to the southern markets may neutralise the additional cost of manufacture of sheet glass in Southern India, where, moreover, a sheet glass factory will have good prospects for exporting to the neighbouring overseas countries. The Panel cites this case of sheet glass only as an illustration of the considerations which must be taken in determining the localisation policy for the industry.

RAILWAY FREIGHT.

59. While on the subject, the Panel would also like to raise the question of revision of railway freight on glassware in relation to the national localisation policy. The freight charged on glassware on different railway lines is very disparate. The E.I.R. is charging railway freight equal to first class rates. Some railways charge second class rates, some fourth and some even higher rates. These rates have to be rationalised and brought in line with a national localisation policy. The Panel, therefore, recommends that the railway freight on glassware should be rationalised on an all-India basis and made more homogeneous than at present and fixed at not higher than first class rates. However, since this is concerned more with the general railway rates policy, the Panel leaves the question of details to the appropriate authorities.

CASE FOR PROTECTION.

60. The case for protection of the glass industry was very ably presented by the Tariff Board set up in 1931. The Panel has gone through all relevant data in this connection. The glass industry is not only one of the major consumer goods industries, but is one of the vital key industries. The annual production of the industry at pre-war price level averaged Rs. 1.5 crores before the war and it has increased very much during the war. The Panel is again duly impressed by a remarkable fact. Whenever the industry has been freed from the pressure of unfair foreign competition, as during the two Great Wars, it has made striking headway, but with the cessation of hostilities, competition of powerful and established industries abroad has tended to smother further development. Already the glass manufacturers are obsessed with the possibility of the repetition of the experience after Great War I. The Panel feels that in order to preserve the industry and foster its further development, the Government should guard it against foreign competition by granting tariff protection for a period within which the industry should develop itself sufficiently so as to be able to stand in the open market even after the withdrawal of protection. Several advanced countries like U.S.A., France, Belgium, Germany, Czechoslovakia, etc., have done this before and the Government of India should at least now realise the importance of the glass industry in our national economy. After examining all relevant data, the Panel is convinced that without the grant of protection, the industry which has expanded considerably during the war, will be unable to withstand foreign competition in the post-war period. The Panel, therefore, strongly recommends that the case of the glass industry should be referred to the Tariff Board for enquiry into the details of the kind and extent of protection for the different types of articles which has to be extended to the industry.

TRADE MARKS AND STANDARDISATION.

61. If the industry is granted protection, which entails the placing of some burden on the consumers, the Panel considers it necessary for the Government to ensure that the industry develops along proper lines so that, within the stipulated period of time, it may organise itself by improving the quality and performance of its products to a level comparable with those of foreign countries. The Panel feels that although it is very difficult to lay down a rigid test, it would be essential to ensure that some kind of check or control is exercised on the proper planning of the industry and the quality of articles produced. The Panel considers that a system of trade marks for the individual factories and the checking up on the quality of products by occasional standardisation by the Central Institute may be of some help in this direction. The Panel however is not immediately in a

position to lay down clearly the details of this control. The Panel recommends the standardisation and laying down of specifications both for raw materials and finished goods. In the absence of such standardisation, the Indian manufacturers cannot be assured of the quality and uniformity of raw materials without which the quality and uniformity of products cannot be maintained. From the evidence the Panel has collected, it is inferred that lack of uniformity of production is one of the chief complaints against Indian made articles. The Central Glass & Ceramic Research Institute, should from time to time lay down specifications for the glass industry and should help in the testing and standardisation of finished products.

SURVEY OF RAW MATERIALS.

62. It is now generally agreed that a proper survey of raw materials is one of the best forms of assistance that can be rendered to an industry especially in a country which is on the eve of large-scale and many-sided development. Unless the raw materials required for this industry are properly surveyed and their occurrences, properties and suitability for specialised purposes are properly charted and assessed, it is difficult to see how an industry can be developed and how its regionalisation can be properly planned. At present whatever information is available is mainly through the records of the Geological Survey of India. Efforts by other agencies have been fragmentary and quite incommensurate with the requirements of large scale development of the industry throughout the country. It is understood that the Council of Scientific and Industrial Research is aware of the importance of this consideration and is contemplating to take some concrete steps in this regard. The Panel is convinced that without a proper survey of raw materials, proper and co-ordinated development of the industry will be very difficult. It, therefore, strongly recommends that the Government should undertake immediately an organised and comprehensive survey of raw materials either under the direction of the Geological Survey or under the Council or under a system of co-operation by both the bodies. The examination of the properties of the samples should be done by one organisation, preferably by the Central Glass & Ceramic Research Institute. The Industrial Research Bureau organised a survey of glass raw materials and quite a large number of samples were analysed. The results of the analysis of samples of sand are reproduced in the Appendix in Statements No. 5 & 6, by the courtesy of the Council of Scientific & Industrial Research.

STATISTICS AND INFORMATION.

63. In its enquiry the Panel has been very much handicapped by the absence of reliable and properly organised data regarding the industry. Even the statistics of total production of glassware in India has never been collected in a proper manner. Again, for example, separate figures for the import of plate and sheet glass, are not shown. At this stage of industrial development, it is impossible to over-emphasise the need for collecting data, properly classified and organised for purposes of enquiries and planning. The Panel suggests that the All-India Glass Manufacturers' Federation which represents the majority of the glass manufacturers in the country, should assist the Central Institute in its task of collection of data. One of the handicaps under which the industry has worked is the lack of information regarding many aspects of glass manufacture. The majority of the factories are not in a position to maintain a well-organised library. The Central Glass & Ceramic Research Institute should, therefore, help in the dissemination of information by (a) bulletins on technical subjects in simple

language and (b) reviews on important topics connnected with the insustry. Further, in order that the Glass manufacturers may have the opportunity of seeing the developments in other countries through the help of models, charts and other exhibits and may also know the position of their own industry vis-a-vis that in other countries, the Panel strongly recommends the establishment of a central museum at the Central Research Institute, where raw materials, finished goods, models of machineries, furnaces, etc., used in this country and abroad as well as charts of production would be displayed.

INDUSTRIAL ASSOCIATIONS.

64. The intense pressure of foreign competition tended to develop a sense of extreme individualism and mutual suspicion among the glass manufacturers in India. The Panel considers that the establishment of representative industrial associations is very essential for the healthy growth of the industry. It is however, opposed to the formation of cartels which ultimately results in crude monopolistic trends. However, the establishment of a central organisation representing the manufacturers is very essential and will also be helpful to the Government in assessing the requirements of the industry from time to time on a collective basis. There are at present 4 zonal associations viz., the Northern India Glass Manufacturers' Association, the U.P. Glass Manufacturers' Syndicate, the Bengal Glass Manufacturers' Association and the South Indian Glass Manufacturers' Association, in addition to the Glass Industrial Syndicate representing bangle manufacturers of Firozabad. There is a central organisation known as the All-India Glass Manufacturers' Federation, which is in the main, a federated body of the four zonal associations. It is understood that the bangle manufacturers' organisation is also joining the Federation. Thus it would appear that the majority of the glass manufacturers have already come under this central organisation. This is a very healthy sign for the industry and will no doubt contribute to its development and stabilisation on a sound basis. The Panel thinks that it will be helpful both to the Government and the industry if the former grant recognition to this central organisation in matters concerning formulation of policy which affect the interests of the industry. The Panel, however, would like to say frankly that this recognition should be accorded only by virtue of the services that the organisation performs not only to its individual members but to the country as a whole and not by way of putting powers into the hands of this central organisation.

COTTAGE INDUSTRY.

65. As the Panel has already pointed out, the Indian glass industry is organised partly on the basis of cottage industry and partly on the basis of large-scale industry. Some important sections of the glass industry such as bangle making, table blowing, bead making and the manufacture of looking glasses and small phials are already working on a cottage industry basis. It appears to the Panel that there is a considerable sector in the industry in which organisation on the basis of small scale production can be profitably developed. At the same time the Panel points out that the process of mechanisation in the large-scale sector of the industry has been much lagging behind compared with that in other countries. The indigenous manufacturers, apart from a few exceptions, have so far paid little attention to the improvement of the efficiency of the glass furnaces and annealing lehrs. There is also urgent need for the import of semi-automatic blowing machines for the glass factories in general. The Panel considers that the Government should give every facility for the early importation of machinery.

CONCLUDING REMARKS.

66. In making its recommendations, apart from the specific points mentioned in the General Directive and the question of attaining the targets for the first five years, the Panel has attempted to take a long range and detached view of the glass industry as a whole. The Panel has presented the causes of the backwardness of the glass industry in India in contrast to the rapid progress which has been achieved in other countries. The position of the glass industry at present in India is very similar to its postion at the end of Great War I in other advanced countries. The Panel has recommended measures which it thinks would help the early removal of the causes of this backwardness. In particular the Panel feels that unless steps are forthwith taken to remove the apprehensions of the industry against the reappearance of foreign competition in an accentuated form, as happened after Great War I, it will be very difficult to establish the confidence of the industry in the efficacy of any measures, however well-intentioned, which the Government may contemplate in the interest of the industry. The Panel has also taken into consideration the necessity of developing the resources of the country in a co-ordinated and balanced manner so that different regions may share duly in the progress of the country and of the industry as a whole. The Panel feels, again, that the progress of the glass industry will depend not only on what the Government does for it but also and especially on what the industry itself is willing and able to do for itself.

67. The Panel also feels that the recommendations that it has made above are of such a character that for some years to come occasional consultations will be necessary. For this purpose the Panel suggests that a small consultative committee consisting of the Chairman of the Panel, a representative of the Central Glass & Ceramic Research Institute, a representative each from the four zonal associations (viz., the Northern India Glass Manufacturers' Association, the U.P. Glass Manufacturers' Syndicate, the Bengal Glass Manufacturers' Association and the South Indian Glass Manufacturers' Association) together with a representative of the all-India Glass Manufacturers' Federation, with power to co-opt specialists, should be constituted after the work of the Panel is over.

SUMMARY OF RECOMMENDATIONS.

The Panel recommends that in the course of the next 10 years, India should aim to reach at least the level which has already been attained by the glass industries in other countries. (Para. 34).

In regard to the sections of the glass industry which have already been developed in India, our aim should be to raise the scale and quality of output to such a level as will enable the requirements of the home market to be met wholly by domestic production. In respect of other sections, production in these lines should be initiated without delay. (Para. 35).

Targets for the first five-year period:—

1. *Bangles.*—Pre-war production was 12,000 tons or Rs. 80 lakhs so that together with pre-war import of Rs. 29.3 lakhs (or 3,000 tons) pre-war consumption totalled Rs. 109.3 lakhs. Present production capacity is 18,000 tons. During the next five years, domestic output should be increased by 10% or 1,800 tons particularly by developing production of fancy bangles which have been hitherto almost wholly imported. (Para. 37).

2. *Bottles and phials.*—Pre-war consumption was Rs. 39.3 lakhs including Rs. 10 lakhs of domestic production and Rs. 29.3 lakhs of imports. Production capacity today is 100,000 tons as against the estimated pre-war capacity of probably about 20,000 tons. No further increase in production capacity is called for, because it is anticipated that an output of 100,000 tons would be enough to meet domestic requirements during the next five years, but quality has to be considerably improved. (Para. 38).

3. *Lampware.*—Pre-war consumption was 9,500 tons valued at Rs. 26.9 lakhs. This included Rs. 20 lakhs (or 7,500 tons) of domestic production and Rs. 6.9 lakhs (or 2,000 tons) of imports. Present production capacity is 10,000 tons. During the war, demand has been repressed only because of scarcity of kerosene. With the removal of this cause, demand may be expected to increase considerably and accordingly, the target has been set at 14,000 tons. (Para. 39).

4. *Tableware.*—Pre-war consumption was 5,000 tons valued at Rs. 14 lakhs of which as much as Rs. 6 lakhs (or 2,500 tons) were imported. During the war production capacity has been raised to 5,000 tons. This should be further stepped up to 7,500 tons. (Para. 40).

5. *Pressed-ware.*—Pre-war consumption was 2,500 tons or Rs. 7 lakhs, including Rs. 5 lakhs (1,500 tons) of import. During the war, production capacity was stepped up to 2,000 tons and this should be further raised to 4,000 tons in the course of the next 5 years. (Para. 40).

6. *Sheet glass.*—Before the war, India consumed 28 million square feet of sheet glass, of which hardly 6 million square feet were produced in the country. The three Indian factories together now produce 13 million square feet, although their rated capacity is 20 million square feet per annum. This is already being further increased to 30 million square feet soon. The target for the next 5 years is set at 42 million square feet, on the assumption that we shall be able to meet the whole of the increased requirements of the home market without recourse to importation. (Para. 41).

7. *Scientific glass apparatus.*—Before the war, we imported Rs. 1.9 lakhs worth of scientific glass apparatus, domestic production being negligible. During the war domestic production increased and was able to meet a considerable part of the country's requirements. With the establishment of more and more scientific and educational institutions, demand is bound to increase several fold and the target for production has been put at Rs. 10 lakhs. Particular attention must be paid to maintaining quality and precision. (Para. 42).

8. *Beads and false pearls.*—Before the war, we imported 4,200 tons valued at Rs. 18.9 lakhs, domestic production being nil. Today, we produce a negligible quantity (120 tons). Proper technical training at home and abroad in this line should be arranged by the Government so that within five years, we may increase our domestic output to 4,200 tons and thus displace the whole of our pre-war import. (Para. 43).

9. *Plate glass.*—Before the war, we imported 3.4 million square feet of plate and flowered glass; the target for the first 5 years should be set at 4 million square feet. (Para. 44).

10. *Optical Glass.*—Figures of prewar consumption of optical glass could not be obtained and consequently, the panel is unable to fix a target. The figure was quite small. But the optical glass industry is a vital, strategic industry and must be started under Government auspices. (Para. 44).

Technical training.

Facilities afforded by existing technical institutes should be further widened in scope as an integral part of the provision of technical training in this country. (Para. 48).

Technical Institutions.

The Central Glass & Ceramic Research Institute at Calcutta which is being started should be suitably provided to discharge its important functions properly. Provincial departments should be affiliated to this Institute in the general policy and working but they should be autonomous in their own activities. The C.G. & C.R.I. should also pay attention to the question of training up suitable technical personnel. A specialised State school like that at Gablonz in Czechoslovakia should be started at Firozabad with experienced teachers trained over there and some experts brought over from there. The laboratory attached to the Glass Technology Section (Government of U.P.) should be transferred from Cawnpore to Firozabad. (Paras. 51-53).

Foreign training.

It would be essential not only to import foreign experts to train our workers in India but also to send suitable Indian personnel with previous training and experience for further training abroad in specific aspects of Glass Technology. This should be done with proper liaison with the industry so that the industry may make full use of their technical knowledge after their return. (Para. 49).

Training of Operatives.

As a first and experimental measure, the following four types of operatives should be brought to India from abroad:—

(i) A foreman for operating semi-automatic machinery in the Blowing Department;

(ii) An engineering worker for maintenance and repair of semi-automatic machinery in the Blowing Department and also experienced in its repairs;

(iii) a smelter for tank furnaces; and

(iv) a foreman of the pressed-ware department.

These men should also be attached to the Central Glass & Ceramic Research Institute and their work be supervised by a Supervisory Committee. They should in no cases be put in executive or administrative posts. (Para. 50).

Cooperation with foreign firms.

In the interest of speedy development of new lines of the glass industry, e.g., optical glass and plate glass industry, the Canadian model of co-operation with foreign firms should be studied. In order to have the technicians trained in a particular art of manufacture, it will be necessary to interest the foreign firms in some form or other. The question of co-operation with foreign firms should be faced on a realistic basis and decided strictly in consonance with our wider national interests. The independence of our industry and final executive control by Indians must be maintained at all costs. (Paras. 45, 46 & 54).

Government ownership.

The glass industry should not be owned by the Government except to the extent and in the manner indicated in the case of establishment of the optical glass and plate glass industries where private enterprise may not be forthcoming adequately at this stage. (Para. 55).

Localisation of the Industry.

On account of the fragile and voluminous nature of the glassware, which does not easily bear haulage over long distances, nearness to the market is of greater determining influence as a locational factor than nearness to raw materials. Thus, it might be economical to start another sheet glass factory in southern India because, the higher cost of manufacture in the South may be counterbalanced by the saving in railway freight on finished products to the southern markets. Manufacture of lampware, tableware, pressedware and sheet glass should be developed in the N.-W.F.P. and Southern India where the glass industry is comparatively less developed now, but raw materials are easily available. A rational localisation policy has to be formulated and enforced through a licensing system so as not to sacrifice the most economic production and efficient utilisation of our resources and transport facilities. With this end in view, the 'zonal system' similar to that existing in the case of the sugar industry may have to be introduced. At the same time, railway freights for glassware will have to be rationalised and made more homogeneous. (Paras. 56-58).

Case for protection.

The case for protection was very ably made by the Tariff Board set up in 1931 and should again be referred to the Tariff Board for enquiry into the details of the kind and extent of protection for the different types of articles which has to be extended to the industry. (Para. 59).

Trade marks and standardisation.

If the industry is granted protection, the Government must ensure that the industry develops along proper lines so that after the stipulated period of time, it could compete with foreign industries in respect of quality and performances of its products. The Panel is not in a position to lay down clearly, the details of this control at this stage. But the institution of a system of trade marks for the individual factories and the standardisation of both raw materials and finished goods would be necessary. (Para 60).

Survey of raw materials.

The Government should undertake immediately an organised and comprehensive survey of raw materials either under the direction of the Geological Survey of India or under the Council of Scientific and Industrial Research. The examination of the proper use of the samples should be done by one organisation. (Para. 61).

Statistics and information.

Statistics regarding the industry should be collected and properly classified and organised for purposes of enquiries and planning. The All-India Glass Manufacturers' Federation should assist the Central Glass and Ceramic Research Institute in the task of collection of data. The Institute should help in the dissemination of information by means of bulletins and reviews and also by the establishment of a Central Museum. (Para. 62).

Industrial associations.

While opposed to the formation of cartels, the Panel considers the establishment of representative industrial associations as very essential for the healthy growth of the industry. The Panel recommends that the Government should grant recognition to the All-India Glass Manufacturers' Federation which it should consult in matters concerning formulation of policy affecting the interests of the Industry. This would be, however, in recognition of the services which the organisation performs not only to its individual members but to the country as a whole and not by way of putting powers into the hands of the Central organisation. (Para. 63).

Cottage industry.

There is a large scope for profitable development on the basis of small scale production in a considerable sector of the glass industry including, as for example, bangle making, table blowing, bead making, the manufacture of looking glasses and small phials, and so on. At the same time, there is an urgent need for greater mechanisation in the large-scale section of the industry. (Para. 64).

Consultative committee.

The above recommendations are of such a character that for some years to come, occasional consultations will be necessary. Accordingly the Panel suggests that a small consultative Committee consisting of the chairman of the Panel, a representative of the Glass Manufacturers' Federation, a representative of the Central Glass and Ceramic Research Institute and a representative each from the four Zonal associations should be constituted after the work of the Panel is over. (Para. 66).

APPENDIX

Statement No. 1

NUMBER OF GLASS FACTORIES IN INDIA

PROVINCES	No. of factories		
	1939	1941	1944
Bengal	12	17	34
Bihar	1	2	8
Bombay	4	5	32
C.P.	3	4	6
Delhi	...	...	1
Madras	1	3	3
Punjab	3	5	6
Sind	...	...	1
Orissa	...	...	1
U.P.	49	79	70
Total British India	74	116	162
Hyderabad	2	2	2
Mysore	1	1	1
Other Indian States	3	4	9
GRAND TOTAL ...	80	123	174

STATEMENT NO. Ia

SHOWING THE PRODUCTION OF GLASS FACTORIES IN INDIA FOR THE YEAR 1945.

Province	Production in tons for 1945.*	Number of factories included.
1. Bengal	55,200	29
2. Bihar	14,100	9
3. Bombay	20,700	15
4. C.P.	3,300	4
5. Delhi	2,100	1
6. Madras	11,400	4
7. Orissa	2,700	1
8. Punjab	6,600	5
9. U.P.	24,300	18
10. Sind	1,200	1
TOTAL	142,500	88
States	**Production in tons for 1945**	**Number of factories included.**
11. Bikaner	1,800	1
12. Dholpur	1,500	1
13. Faridkot	900	1
14. Gwalior	900	1
15. Hyderabad	3,300	1
16. Jaipur	900	1
17. Kotah	1,500	1
18. Mysore	450	1
TOTAL	10,950	8
GRAND TOTAL ...	153,450	96

*The production figures have been calculated on the basis of returns which have been received in reply to questionnaires issued by the Panel. The returns, it is believed, in many cases indicated the production capacity, rather than actual production in the year.

Statement No. 2

VALUE OF GLASSWARE (MANUFACTURED IN INDIA) EXPORTED FROM INDIA

(Thousands of Rupees).

	1929-30	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41
Aden & Dependencies	3.3	3.3	4.0	5.1	2.7	1.8	2.4	5.1	5,0	1.8	4.6	13.5
Bahrein Islands ...	2.1	1.1	1.7	1.5	6.8	1.5	1.0	8.0	16.6	12.2	7.8	8.4
Ceylon (excluding Maldives ...	15.4	10.4	6.2	14.5	6.3	9.0	7.3	8.3	16.2	9.7	15.6	87.4
Burma ...	...	...	...	...	....	...	...	...	54.1	57.3	85.3	195.0
Federated Malay States... ...	5.3	4.4	1.7	1.5	.7	3.6	2.0	.5	7.5	6.8	3.8	5.2
Other British possessions.	29.3	28.2	21.9	8.5	9.0	11.1	6.7	7.0	11.0	8.4	20.4	78.3
Native States in Arabia ...	8.3	3.1	2.7	2.2	3.4	2.3	2.3	14.9	4.6	5.3	12.5	20.1
Iran	2.4	3.9	1.5	1.3	.4	4.6	3.5	2.1	6.9	7.6	7.0	16.1
Other foreign countries	16.3	6.7	6.5	8.0	16.7	7.9	4.5	3.3	7.7	6.1	12.6	159.8
TOTAL ...	103.5	61.2	46.0	44.7	45.9	42.9	29.6	49.2	129.6	115.2	169.0	583.8

Statement No. 3

VALUE AND QUANTITY OF GLASSWARE IMPORTED INTO INDIA
(In lakhs of Rupees)

	1927-28	1928-29	1929-30	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41
Bangles	89.5	76.8	85.2	49.9	34.5	39.9	27.1	31.1	27.2	28.0	29.3	24.2	18.4	6.9
Beads and false pearls ...	26.6	30.4	30.6	15.7	9.4	12.4	13.4	13.1	15.3	12.2	18.9	13.4	8.5	3.5
Bottles and Phials ...	33.0	36.2	39.5	29.9	24.1	24.4	21.1	24.8	30.2	23.6	29.3	28.0	20.6	24.8
Bottles and Phials Gross (lakhs)	...	...	7.0	6.2	4.6	8.1	7.9	8.3	10.4	8.5	11.9	9.8	...	....
Lampware	22.2	19.6	21.1	12.3	7.5	6.7	5.1	5.7	6.0	6.1	6.9	5.2	3.8	2.0
Scientific Glassware ...	1.7	1.7	1.3	1.4	1.2	1.4	1.2	.9	.7	1.5	1.9	1.9	...	...
Sheet and Plates ...	29.9	29.7	31.0	23.9	19.7	23.1	21.2	23.7	24.3	21.3	25.4	23.7	19.9	17.5
Sheet & Plates sq. ft. (lakhs)	...	...	222.0	198.0	157.5	186.2	195.4	247.6	309.2	273.3	210.1	270.7	...	...
Tableware	9.4	10.9	13.3	9.5	5.9	5.4	5.3	5.5	4.6	4.5	6.0	5.9	...	...
Other glassware* ...	36.1	32.3	29.9	22.2	19.6	29.2	27.7	27.7	31.1	30.8	34.2	22.9	30.6	31.6
TOTAL ...	248.4	237.5	251.9	164.8	122.0	142.5	122.1	132.6	139.4	127.9	151.4	125.1	101.8	86.3
Electric Bulbs** ...	...	...	...	...	35.3	96.0	34.3	38.0	39.9	33.0	89.8	28.0	26.3	21.6

*Electric Lamp Bulbs are not included.
**Figures available from 1931-32. The cost of the glass shell is of course only a fraction of that of the electric bulbs.

STATEMENT No. 4

PERCENTAGE OF VALUE OF GLASSWARE IMPORTED FROM DIFFERENT COUNTRIES IN 1929-30 AND 1938-39.

	Czechoslovakia		Japan		Germany		British Empire		Belgium		Others	
	1929-30	1938-39	1929-30	1938-39	1929-30	1938-39	1929-30	1938-39	1929-30	1938-39	1929-30	1938-39
Bangles ...	65.4	39.1	29.3	54.1	2.0	1.8	...	2.1	...	...	2.4	3.8
Beads and false pearls	37.1	32.8	30.5	36.3	5.7	6.7	...	...	...	...	26.4	25.1
Bottles—Sodawater-bottles ...	...	...	...	64.4	46.8	20.7	46.3	18.0	...	...	6.9	.9
Other bottles and Phials ...	...	5.1	55.8	64.0	20.4	20.3	16.1	6.6	...	...	7.7	4.0
Lampware ...	5.6	15.5	11.2	13.7	44.8	48.9	...	8.1	6.5	...	31.9	13.8
Scientific glassware	...	...	9.2	20.7	56.6	57.0	25.9	18.6	...	...	8.3	3.7
Sheet and Plates ...	6.2	2.9	5.4	30.2	5.0	12.3	16.2	12.2	60.5	40.6	6.7	1.8
Tableware ...	2.1	5.8	68.0	72.2	8.7	6.8	7.0	10.3	11.4	...	2.8	4.9
Other kinds ...	...	4.8	43.4	52.1	19.1	10.9	18.1	16.0	6.6	...	12.8	16.2
All sorts ...	28.4	14.3	29.4	48.0	13.6	13.4	9.5	8.0	9.4	7.7	9.9	8.6

STATEMENT No. 5

MECHANICAL ANALYSES OF SANDS (Sieve test on a. s. t. m. mesh sieve)

Origin of sand.	Percentage fraction of sand: Retained on 8 mesh sieve	Passing 8 mesh but retained on 16 mesh	Passing 16 mesh but retained on 30 mesh	Passing 30 mesh but retained on 50 mesh	Passing 50 mesh but retained on 100 mesh	Passing 100 mesh
1.	2	3	4	5	6	7
			U.P. SANDS			
Bargard	...	0.07	1.87	11.85	70.00	16.21
Bargard	...	...	0.03	7.50	77.50	14.97
Bargard	0.04	2.15	4.00	11.50	63.15	19.16
Bargard	...	0.10	0.20	3.51	83,76	12.43
Bargard	...	0.19	2.65	7.40	61.25	28.51
Bargard	...	0.01	2.35	9.75	77.50	10.49
Panhai	0.2	17.7	7.8	7.6	31.1	35.6
Panhai	...	2.8	7.8	47.7	33.6	8.1
Lohagra	...	3.7	5.90	19.20	60.70	10.5
Lohagra	...	0.8	1.8	12.8	73.6	11.0
Dabhansa	...	0.1	4.02	7.20	76.00	12.68
			JUBBULPORE SANDS (C.P.)			
Jubbulpore	...	2.74	4.25	43.74	37.74	11.47
Jubbulpore	...	...	5.20	41,50	48.00	5130
Jubbulpore	0.09	2.90	3.25	39.00	42.55	12.21
Jubbulpore	0.40	4.51	4.72	35.71	45.60	9.06
			BOMBAY PRESIDENCY			
Walwall Hills	0.4	0.6	23.8	37.1	27.7	10.4
Ghadegri	...	0.4	12.7	32.5	36.0	18.40
			BIHAR (SANTHAL PARGANAS)			
Mangalhat (Hadap Hill Quarry East.)		0.8	7.6	25.4	38.7	21.1	6.4

STATEMENT No. 5 (*Contd.*)

1	2	3	4	5	6	7
Mangalhat, (Hadap Hill Quarry North.)	3.0	30.2	27.6	18.0	18.1	3.1
Mangalhat, near Bemgalow	0.7	6.6	9.7	30.8	38.4	13.8
Mangalhat, sampled from factory stock	5.0	32.8	14.6	36.8	10.3	0.5
Mangalhat, washed	...	0.1	14.6	38.5	39.8	7.0
		MADRAS PRESIDENCY				
Ernavur	0.1	8.9	21.6	36.8	29.5	3.10
Chirala Surface layer	...	3.4	34.5	32.5	24.0	5.6
Chirala lower state	...	0.8	11.8	37.0	46.1	4.8
Baptala	...	0.1	1.5	15.3	76.1	7.0
		TRAVANCORE STATE				
Kakothamangalam Shertallai	...	0.75	9.55	32.75	48.75	8.20
Kizhakummuri	...	2.99	16.92	44.20	11.79	24.10
Thuravoor	...	0.71	6.27	42.32	46.78	3.92
Vylar	...	1.35	17.49	42.00	33.05	6.20
PALLANAKAD Kamppan	...	1.5	14.25	40.75	37.00	6.50
Kalangara	...	1.10	8.90	38.00	49.50	2.50
Thirumallor	...	0.90	13.10	45.90	34.00	6.10
Chinnanpallipuram	...	1.24	9.25	32.25	48.75	8.51
Pallipuram	...	1.15	14.76	30.60	45.75	7.74
Allipuram	...	0.40	9.43	40.46	43.75	5.96
Thycattasiri	...	1.95	11.40	24.88	27.94	33.83
Panavelli	...	1.05	15.08	31.35	46.45	6.17
Panavelli	...	0.35	6.60	27.10	56.25	9.70
Marangurvattam	...	0.85	16.25	56.45	24.07	2.38
Kaluar	...	1.01	18.25	57.7	44.52	1.34
Rasikan Kannu	...		2.73	46.62	44.52	6.13
Rasikan Kannu	...	...	3.39	48.01	43.24	5.33
Rasikan Kannu	...	0.03	1.51	19.75	72.10	7.62
Rasikan Kannu	...	0.02	2.42	21.71	68.73	7.14
		HYDERABABAD STATE				
Deccan (Nalwar Nallah)	...	0.20	18.80	43.90	33.8	13.30
		MYSORE STATE				
Talakad	...	...	2.1	19.9	93.6	14.1

STATEMENT No. 5 (*Contd.*)

1	2	3	4	5	6	7
		RAJPUTANA STATE				
Swai Madhopur	...	0.04	2.80	29.23	49.40	18.53
		KASHMIR STATE				
Dan Talav	...	0.40	12.60	42.10	22.00	29.90
		PUNJAB				
	Retained on 16 mesh	Passing 16 mesh but retained on 30 mesh		Passing 30 mesh but retained on 60 mesh	Passing 50 mash but retained on 100 mesh	Passing 100 mesh
Ghaggar	0.1	0.0		0.5	54.0	45.40
Jeijon Doaba No. 1	...	2.3		47.8	39.4	10.5
Jeijon Doaba No. 2	0.03	8.48		31.00	44.20	16.29

STATEMENT No. 6

CHEMICAL ANALYSES OF SANDS

Origin of Sand	Moisture	Constituents of the Dried Samples								
		Loss on ignition	SiO_2	Fe_2O_3	TiO_2	Al_2O_3	CaO	MgO	Na_2O+K_2O	Total
1	2	3	4	5	6	7	8	9	10	11
				UNITED PROVINCES						
Bargarh	0.12	0.60	96.70	0.06	0.12	1.65	0.30	0.27	0.17	99.87
Bargarh	0.10	0.70	96.57	0.03	0.18	1.73	0.30	0.27	0.05	99.83
Bargarh	0.21	0.85	95.84	0.04	0.16	1.53	0.83	0.19	0.70	100.14
Bargarh	0.21	0.62	97.10	0.03	0.12	1.09	Trace	0.16	0.80	99.92
Bargarh	0.19	0.45	95.70	0.10	0.12	2.85	0.30	0.19	0.26	99.97
Bargarh	0.25	0.85	95.65	0.07	0.22	1.98	0.42	0.48	0.30	99.97
Panhai	Trace	0.30	94.75	0.13	0.04	3.31	0.23	0.22	0.95	99.93
Panhai	0.02	0.40	97.92	0.03	0.02	0.83	0.16	0.18	0.50	100.04
Lohagra	Trace	0.37	98.86	0.05	0.01	0.61	0.10	Trace	0.05	100.05
Lohagra	0.02	0.43	98.02	0.06	0.07	0.64	0.20	Trace	0.30	99.72
Dabhaura	0.00	0.51	97.50	0.05	0.08	0.76	0.20	0.35	0.30	99.75
				PUNJAB						
Ghaggar	0.35	1.71	89.31	4.27	0.40	2.44	1.08	0.47	0.75	100.49

STATEMENT No. 6 (*Contd.*)

1	2	3	4	5	6	7	8	9	10	11
				JUBBULPORE (C.P.)						
Jubbulpore	0.22	1.05	94.05	0.06	0.38	3.65	0.50	0.28	Nil	99.97
Jubbulpore	0.12	0.63	96.60	0.04	0.28	1.57	0.20	0.47	Nil	99.73
Jubbulpore	0.47	1.78	96.25	0.06	0.08	0.83	0.18	0.28	0.57	100.03
Jubbulpore	0.20	1.35	95.15	0.04	0.20	2.57	0.10	0.21	0.36	99.98
				BOMBAY PRESIDENCY						
Ghodegri	Trace	0.65	93.67	0.49	3.00	0.30	0.68	1.01	0.05	99.85
				BIHAR						
Maugalhat	0.02	0.30	99.00	0.14	0.25	0.39	Trace	Nil.	Trace	100.08
Maugalhat	0.03	0.45	97.83	0.17	0.41	1.10	Trace	Nil.	Trace	99.96
Maugalhat	0.10	0.55	97.08	0.30	0.65	1.53	Trace	Nil.	0.23	100.34
Maugalhat	0.16	0.54	99.08	0.05	0.08	0.33	Trace	Nil.	Trace	100.80
Maugalhat	Trace	0.57	97.65	0.05	0.33	1.10	Trace	Nil.	0.20	100.23
				MADRAS PRESIDENCY						
Ernavur	0.17	0.27	96.29	0.15	0.16	1.89	0.62	0.17	0.14	99.69
Chirala	0.23	0.44	91.44	1.17	0.20	6.67	0.34	Trace	Trace	100.26
Chirala	0.15	0.37	90.40	0.74	0.14	5.69	1.83	0.50	Trace	99.67
Baptala	0.14	0.36	90.70	1.45	0.40	4.78	0.24	0.18	1.87	99.98

STATEMENT No. 6—(*Contd.*)

1	2	3	4	5	6	7	8	9	10	11
				TRAVANCORE						
Kakothamangalans Shertallai	Nil.	0.20	95.90	0.24	0.88	2.40	Nil.	0.40	0.20	100.22
Kishakkummuri	Nil.	0.45	95.05	0.21	1.12	2.72	Trace	0.27	Trace	99.80
Thuravoor	Nil.	0.50	93.70	0.32	1.16	3.07	0.50	0.26	Nil.	99.51
Vylar	Nil.	0.32	95.03	0.13	0.80	3.32	Trace	0.19	Trace	99.79
Pallanakkad Kamppan	Nil.	0.41	97.65	0.04	0.36	1.00	0.15	0.32	Trace	99.93
Kalangara	Nil.	0.30	97.25	0.08	0.56	1.61	Trace	0.21	Trace	99.99
Thirunalloor	Nil.	0.30	96.85	0.17	0.96	1.07	0.25	0.25	Trace	99.85
Chinnarpattipuram	Nil.	0.32	96.40	0.12	0.28	1.05	0.35	0.43	0.62	99.57
Pallipuram	Nil.	0.45	95.29	0.16	0.52	1.57	0.25	0.36	0.25	99.85
Allipuram	Nil.	0.20	97.55	0.05	0.48	1.47	Trace	0.31	Trace	100.06
Thycattuseri	Nil.	0.35	97.15	0.03	0.20	1.36	Trace	0.36	Trace	99.47
Panavalli	0.06	0.30	95.90	0.10	0.32	3.28	Trace	Trace	0.12	100.02
Panavalli	0.03	Trace	95.50	0.14	0.36	3.00	Trace	0.20	0.10	99.30
Marimgirwattam	0.05	0.20	94.70	0.67	1.96	1.47	0.30	0.30	0.10	99.70
Kalavur	0.04	0.20	96.40	0.24	0.76	0.80	0.50	0.43	Trace	99.35
Rasikan Kannu	Nil.	0.25	96.80	0.46	1.40	1.02	0.11	0.34	Nil.	100.02
Rasikan Kannu	Nil.	0.45	96.50	0.35	0.60	0.60	0.25	0.39	0.20	99.49
Rasikan Kannu	0.05	0.10	92.20	1.10	2.76	3.04	Nil.	0.42	0.10	99.72
Rasikan Kannu	0.06	0.01	95.30	0.42	1.00	2.58	Nil.	0.40	Trace	99.80

STATEMENT No. 6 (*Contd*).

1	2	3	4	5	6	7	8	9	10	11
				HYDERABAD STATE						
Deccan (Nalwar Nullah)	0.32	1.45	85.44	0.58	0.06	7.97	1.94	0.58	2.08	100.10
				MYSORE STATE						
Talakad	0.05	0.46	85.48	0.45	Trace	9.48	1.24	0.84	2.18	100.13
				RAJPUTANA STATE						
Swai Madhopur	2.0	0.60	96.30	0.07	0.16	1.98	0.25	0.29	0.24	99.95
				KASHMIR STATE						
Ban Talau	1.98	2.87	75.40	3.35	0.58	12.35	1.14	0.76	3.44	99.89

Note:—The above tables (Statement No. 5+6) have been compiled from the so far unpublished work on "Survey of raw materials for glass manufacture in India" carried out in the laboratories of the Industrial Research Bureau, Calcutta, during the period 1936-40. Publication of the full report has been delayed due to war time conditions and is expected to be undertaken shortly.

The analyses relate to washed Sands.

DIS. 27,
1650

REPORT

OF THE

PANEL ON WOOLLEN INDUSTRY

JAIN BOOK AGENCY
GOVT. BOOK ... ETS,
CONNAUGHT PLACE
NEW DELHI.

GOVERNMENT OF INDIA
Department of Industries & Supplies

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I to XV.

The Government of India in the Planning and Development Department constituted a panel on the Woollen Industry to make recommendations regarding its development—*vide* Planning and Development Department D. O. No. P-1 (22)/44, dated 16th February 1945. The Panel held its sittings on the following days :—

13th October, 1945, and 25th April, 1946.

2. Informal sittings of the Panel were also held for about seven days in May, 1946. The members of the Panel have great pleasure in submitting to the Planning and Development Department the enclosed report on the development of the Woollen Industry in India.

New Delhi
22nd May, 1946.

A. K. Wattal	...	Chairman.
W. R. Watt	...	Members.
J. O. Lal	...	
S. Ratnam	...	
Jiwandas Bhagwandas	...	
H. K. Khanna	...	

REPORT ON THE WOOLLEN TEXTILE INDUSTRY IN INDIA.

1. Brief Historical Narrative.

India has a long tradition of handspinning and handloom weaving of wool but it was not till the eighteen-seventies that the powerloom was used in the manfacture of woollen goods. The indigenous hand industry covered a wide range of qualities from coarse blankets made on the plains to the fine shawls for which Kashmir has been so famous. In the beginning the powerloom factories produced coarse goods particularly blankets but in course of time the variety of fabrics produced by them multiplied and by the eighties some woollen mills had begun to instal plant for the production of worsted yarns and cloth.

2. The use of worsted yarns however resulted in an increased installation of powerlooms—a step which had far-reaching consequences on the woollen textile industry. The first woollen mills to be set up in India about 1876 were at Cawnpore and Dhariwal. There were no special reasons for locating the mills at these places except perhaps that they provided cheap labour and good water supply. A few years later a mill was opened at Bombay and another at Bangalore, the latter restricting itself entirely to the production of cheap blankets made from the South Indian wools. The Cawnpore, Dhariwal and Bombay mills from the start made use of the finer qualities of East Indian wools and while on the addition of worsted departments they continued to use the same wools for woollen production, the demand from urban areas for the better quality of article was met by importing Australian wools. The cottage industry of carpet making in the United Provinces and the Punjab was also organised and some mills were set up at Amritsar and elsewhere chiefly for spinning carpet yarn. In these mills the manufacture of coarse cloth and blankets was subsidiary to the main purpose of producing yarn for carpet looms.

3. The first world war (1914-19) gave a fillip to the industry and all the mills and many handlooms were fully utilized for the production of warm clothing for the Army. The fabrics then chiefly in demand were blankets, greatcoat cloth, flannels and serges. On the conclusion of that War there was much leeway to be made up in supplying the public demand and the capitalists of India and of Bombay in particular did not fail to grasp the opportunity. Between 1919-20 some more mills were started in Bombay, Amritsar and Bangalore and the capital invested in the industry

reached the total of nearly two crores of rupees. The mills started in this period were the IndianWoollen Mills, the WadiaWoollen Mills, the Dharamsi Morarji Mills, the Kaiser-i-Hind. Woollen Mills, the Maharani Woollen Mills and the Oriental Carpet Manufacturers. Of these the first two were fitted out for the production of woollen and worsted fabrics, the third for the manufacture of worsteds and the last three for the manufacture of woollens only.

4. But prosperity after the last World War was shortlived in all industries and the newly established woollen mills for which plant had been purchased at high prices soon found themselves in difficulties which were aggravated by lack of Government demand, sales of surplus War stores and a huge volume of foreign imports. The conditions in the early nineteen-thirties were even less favourable partly due to the chaotic exchange conditions and partly to the expansion of imports particularly from Japan. It may be stated here that the total imports of woollen piece-goods in 1934-35 were 13,735,000 yards as against 5,516,000 yards in 1931-32 ; the Japanese imports during the period increasing from 1, 21,000 yards to 7,268,000 yards. Customs statistics relating to the Woollen trade are given in statements I to xv appended to this Report.

5. Representations were made to the Government of India who constituted a Tariff Board in 1934 to report on the claim of the Woollen Textile Industry for protection. In June, 1935 the Board submitted their report which *inter alia* contained the following recommendations :—

(*i*) that a specific duty of four annas per lb. combined with an *ad valorem* duty of 25 per cent be imposed on all woollen blankets subject to a minimum duty of rupee one per blanket ;

(*ii*) that a specific duty of one rupee per lb. with an alternative *ad valorem* duty of 35 per cent be levied on all piece-goods classified as woollen ;

(*iii*) that an *ad valorem* protective duty of 40 per cent *plus* an exchange compensation duty of 37 per cent be fixed on all worsted shawls and piecegoods imported from Japan ; and

(*iv*) that mixtures which come under the classification of woollens should be subject to the same specific duty or *ad valorem* duty as pure woollens and worsted mixtures to a similar *ad valorem* duty as pure worsted goods.

6. The Government of India, however, did not accept these recommendations. They held the view that as the worsted branch of the industry was dependent on imported raw material it did not satisfy the first condition laid down by the Fiscal Commission, and had, therefore,

no claim for protection. As regards the woollen branch, the Government of India considered that the recommendations of the Tariff Board were vitiated by the fact that a very important section of the industry had failed to tender any evidence before the Board about the cost of manufacture and the nature of the competition experienced by it. However, the Board's suggestion that the small scale woollen industry needed technical advice and assistance was accepted and a grant of Rs. 5 lacs spread over five years was sanctioned for this purpose. The development achieved to date as a result is described in Annexure I.

7. While large imports of piece-goods kept pouring into India from Japan, there were also substantial imports of worsted yarns which played a prominent part in the development of the industry. These imports resulted in the establishment in Amritsar of a large number of small worsted powerloom weaving mills and in Ludhiana of many hosiery knitting factories. The Amritsar mills began producing shirtings light weight suitings, shawls, serges, etc. With the outbreak of hostilities with Japan in 1941 the supplies of these yarns were entirely cut off, but the Government of India were able to procure some yarns from the United Kingdom and Australia which helped at least a portion of this valuable industry to keep alive.

8. At the outbreak of this War (1939) there were fifteen woollen mills in India. The Tariff Board had estimated the total capital invested in the industry in 1935 at Rs. 2,40,00,000 ; but since the bulk of the Amritsar units were erected thereafter, the total capital invested at the end of 1939 can safely be taken as somewhere between three and four crores of rupees. Of the fifteen mills, four were fitted out for making both woollens and worsteds, one was purely a worsted yarn spinning mills putting a small quantity of knitting yarn on the market, while the rest were mainly woollen mills producing rugs and coarse woollen cloth. Two new woollen mills, one at Allahabad and another at Bangalore were started in 1943 for producing blankets. The Supply Department invited all the woollen mills in India to undertake production for the Defence Services on a hundred per cent basis, *i.e.*, entirely cease manufacture of woollens for the civilian market. The mills agreed and have been working two-three shifts a day. The annual out-turn per shift has increased to nearly fifteen million pounds as against seven million pounds just before the War. The mills have been chiefly producing serges, shirtings, drab mixtures, flannels and overcoatings. As the range of the materials required by the Supply Department was limited the mills have been able to produce standardized fabrics. The contracts for Defence textiles with these woollen mills were negotiated

by Government on the basis of cost plus profit. Though the profits were fixed at 7½ per cent of the basic cost which was the cost ruling in 1941, the net yield to the mills in later years was less than this percentage as current costs had risen above the 1941 levels. The Federation of Woollen Manufacturers in India representing these mills more than once represented on the inadequacy of the profit margins, especially as compared with returns secured by other industries on war contracts, notably cotton, but Government in the Supply Department vigorously resisted such demands, and it should be recorded to the credit of the woollen mills composing the Federation that they honoured their contractual obligations with the Government without a demur. The low profit margins and most other handicaps like absence of adequate spare parts and fuel supplies did not prevent the industry from putting in its best during all the war years.

9. During the last thirty years and particularly since the first World War, there has been a general tendency to produce materials of better quality, although the production of coarse blankets is still continued. The workmanship also has improved and there is a greater variety of designs available. On the woollen side the chief volume of business is done in medium and coarse qualities, such as blankets, uniform cloth, tweed, etc, while on the worsted side the tendency towards finer qualities has been more pronounced. The production in India of light weight worsteds has been largely assisted by the development of the mills in the Amritsar area using imported Japanese yarn of finer counts than those spun by the Indian worsted mills. The Indian mills, however, were not able to compete with much success with the cheap shoddy rugs, etc., imported from Italy and Poland in pre-war days. Inadequate supplies of rags which form the basic raw material for shoddy fabrics appear to have been responsible for this. It seems probable that even after the end of this war some woollens like billiard cloth, special types of greatcoat cloth, over coating, etc., and worsteds like Gaberdines, light-weight mixtures and other fine dress materials will have to be imported unless some of the old and new mills establish equipment suitable for the manufacture for such articles.

10. The sub-joined table gives a rough idea of the existing capacity of the mill industry :—

Woollen spindles	...	50,000
Worsted spindles	...	37,500
Powerlooms (including those at Amritsar)	...	2,300
Handlooms in mills	...	500

Details are given in Annexure II.

II. RAW MATERIALS

11. The chief raw material for the industry is wool, and although the quality of the wool produced in India is generally inferior, the quantity is ample. Indian wools are known in the world trade as "East India Wools" although this term includes not only Indian wools but also wools from Persia, Iraq, Afghanistan and Tibet. India both imports and exports wool. The imports come by land and sea; by land from Afghanistan, Persia, Central Asia, Tibet, etc., and by sea from Persia, Iraq, Australia and the United Kingdom. Amritsar, Kalimpong, Shikarpur, and Multan are the main collecting centres for wool imported by land and Karachi and Bombay are the chief ports through which wool is both imported and exported. The largest market in India for indigenous wool is Fazilka in the Punjab.

12. Most Indian woolls are unsuited for the worsted process and the worsted industry, therefore, is mainly dependent for its raw materials on imports. Some of the finer types of wools imported by land have been, and on the return of normal conditions will probably again, be, used in the manufacture of worsted yarns. As regards woollens, the indigenous wools and some of the wools imported by land can only be used for the coarser type of yarns and cloths. For finer and softer types, mills will have to depend on imported wools.

13. Roughly speaking, the utilization of wool by the Indian mills may be classified as follows :—

Indian plain wools ...	*Coarse types* :	Army blankets and woollen carpet yarns.
	Finer types :	Tweeds, overcoatings, broadcloths, civilian blankets, rugs and serge weft yarns.
Hill types :		Serge yarns and low grade hosiery, coloured—Army blankets and coarse hosiery.
Crossbred Wools :		Medium serge warps, worsted warps and wefts and medium hosiery yarns. Short wools of this quality are used for tweeds, broad cloths, overcoatings, etc.
Merino Wools :		The shorter stapled merinos are used by the woollen industry for producing flannels, overcoating and superfine broadcloths. The longer stapled merinos are chiefly used for hosiery yarns and fine worsteds.

14. Of the remaining raw materials, mention may be made of the various types of artificial fibres used for mixing with wools, sizing materials, dye-stuffs and chemicals. Except during this war and

the last one when the supplies of dye-stuffs became scarce, the woollen textile industry has never found any difficulty in obtaining these raw materials in India. There is no reason to presume that the progress of the industry will be hampered by the shortage of these materials in the post-war period.

15. Mention may be made here of a serious handicap from which the Indian woollen industry suffers. The season for wearing woollen clothes in India is about four months in a year ; hence it is necessary for the mills to manufacture for many months largely in anticipation of a demand which may never be realised. This puts the industry in an awkward situation for it is a matter of some difficulty to forecast the type of cloth for which the demand will arise. The difficulty in the case of certain mills which produce hundreds of patterns a year is greatly enhanced. An additional risk is run by many of the units of the industry which disclose fixed prices in May and June to remain current for a year. The prices of raw materials may move against the manufacturer ; his range of patterns may not suit the public and what might have been a reasonable manufacturing programme may result in his accumulating stock of manufactured goods which can be sold only at a considerable sacrifice.

III. FUTURE OF THE INDUSTRY

16. A statement giving the names of the various woollen textile mills in India is to be found in Annexure II. Before the out-break of this war the woollen mills acted independently of each other with resultant rivalry and competition. But war conditions made the established mills recognise that it would be to their advantage to have a central body for negotiating with the Government of India, particularly in regard to the requirements of the Defence Services and they formed a Federation for the purpose. This body, styled as the Federation of Woollen Manufacturers in India, was also to act as a central body in all matters connected with the industry or common to the individual members. The Government welcomed such an Association as it rendered the task of negotiation and placement of orders easier. That Federation formed with the aforesaid objects is likely to further the cause of the industry cannot be denied ; hence its continuance in the post-war period is strongly advocated. The Federation would justify its existence even if it is able only to eliminate the intense competition which existed among the various units of the industry in the pre-war years.

A similar urge to secure orders for Defence woollen textiles on a non-competitive basis was at the bottom of the consolidation which was effected in the position of Textile Manufacturers Association, Amritsar.

This Association embraces practically all the powerloom weavers and certain woollen spinners of Amritsar. During the war the Association acted as a Central Purchasing Agent for all the requirements of member mills. If in the post-war period the Association enlarges its scope to embrace marketing of products also, it would be discharging a very useful function. The new woollen mills which are likely to be established in the post-war period will naturally affiliate themselves to one or other of these two bodies if they are to withstand competition.

The present location of the various units of the Industry is to a fair extent on rational lines. There is nothing to criticise about the proposed location of the new woollen worsted mills for which capital issues have been sanctioned. The Industry should continue to be run under private ownership as at present.

17. Statements I to XV give details of imports and exports of wool and woollen manufactures. The sub-joined table gives in summarised form the average annual imports and indigenous manufacture of woollen goods during the year 1936—1939 and our estimate of India's requirements during the first five years of the post war period. In general the estimates of post-war consumption are 60 per cent. above the pre-war figures. But we have also made adjustments in cases where it was felt that the resulting figure might be either too high or too low due to changes in taste of the people or to technical considerations. The figures in the last column of the table are to be treated as the recommended targets of production.

a=Imports. *b*=Indian production.

Item.		1936—1939 Average pre-war Consumption (*i.e.*, pre-war import+ Indian production. lbs.)	Estimated Indian requirements during the first 5 post-war years. lbs.
Woollen Knitted Apparel	*a*	269,000	
	b	950,000	2,200,000
		1,219,000	
Woollen Worsted Piecegoods	*a*	2,153,000	
	b	1,347,500	5,500,000
		3,500,500	
Mixtures Piecegoods	*a*	1,413,000	
	b	74,500	2,500,000
		1,487,500	
Blankets and Rugs	*a*	3,635,000	
	b	2,137,000	9,400,000
		5,772,000	
Worsted Yarn for Weaving	*a*	1,617,000	
	b	59,000	3,000,000
		1,676,000	
Knitting wools and Hosiery Yarns	*a*	1,169,000	
	b	430,000	2,600,000
		1,599,000	
Shawls and Lohis	*a*	Nil.	
	b	672,500	1,000,000
		672,500	
Carpet Yarns (Woollen Yarns for carpets and Blankets)	*a*	Nil.	
	b	1,856,000	3,000,000
		1,856,000	
Mechanical Cloth	*a*	144,000	
	b	67,000	300,000
		211,000	
Other goods	*a*	700,000	
	b	334,000	1,000,000
		1,034,000	

Possibilities of exports to the near east markets have not been taken into consideration in arriving at the foregoing target figures. But there is bound to be a certain volume of imports of woollens into the country, and an equivalent quantity of indigenous production may be treated as available for export. It is very difficult to assess what the competitive position in those markets will be, but we have every hope that the cheaper type of woollen goods will find favour

The approximate Indian consumption of mill, made goods in India should be at least 60% more than it was before the war. The reasons for this anticipation are :—

1. Increase in population.
2. Increase in the purchasing power of the people due to earnings during the war.
3. Increase in the purchasing power due to post war efforts for raising the standard of living of the people.
4. Increase in demand for mill-made yarns by the handloom industry. It is anticipated that with the rise of the wage earning capacity of workmen it will not be found economic to go in for hand spinning of wools to the same extent as before the war, and the cottage industry will depend more and more on yarns produced by the mills. A further increase in the consumption of woollen yarns during the next five years will be on account of the great demand (both local and foreign) for Indian hand made carpets—a demand which was at its lowest during the five years preceding the war.

The consumption during the post-war period would be considerably increased if the Indian mills were able to produce cheaply some of the types of goods which were extensively imported before the war thus enabling a larger number of people to buy mill made woollen goods.

Both the Federation of Woolen Manufacturers in India and the Textile Manufacturers Association will be discharging a very important duty if they impressed on the member mills the necessity for re-arranging their economies so as to enable them to produce such goods.

A study of the Import figures of the 5 years preceding the war viz., 1935-36 to 1939-40 would indicate that :—

(*i*) Imports kept on increasing from 1935 onwards and reached a peak in 1937-38. The drop during subsequent years was probably due to war preparations and later to a state of war itself.

(*ii*) The weight of the piece goods imported averaged 8 ounces to a yard against the Indian average of 16 ounces to a yard. This would indicate that the country in the main wanted more of the lighter weight

fabrics and was not satisfied merely with the heavy weight fabrics produced in India.

(*iii*) There was a considerable demand for cheap but soft blankets and rugs of the type made on the Continent. These blankets were cheaper than those produced in India mainly because of the use of cheap, short but soft wools and of opened wools and shoddies. Indian mills would be well advised to go in for this type of fabrics, for which there is bound to be a further increasing demand.

(*iv*) The average of the five years is very much below the peak figures of 1937-38. Calculations based on the pre-war average can therefore be correctly regarded as conservative.

(*v*) Amongst the imported goods the share taken by foreign countries was approximately as follows (comparison has been shown only in cases of those countries which were responsible for the bulk of imports) :—

(*a*) Worsted yarn for weaving,	Japan 4 to United Kingdom 1
(*b*) Knitting yarns,	Japan 3 to United Kingdom 1
(*c*) Blankets and rugs,	Italy 25 to the rest 1
(*d*) Hosiery,	Japan 8 to United Kingdom 1
(*e*) Wollen and worsted piece goods,	Japan 3 to United Kingdom 1
(*f*) Piece goods made out of mixture of wool and other materials,	Japan 1 to United Kingdom 4.

(*vi*) Considering that the bulk of imports were from enemy countries, the desire of India to be independent of such imports can be appreciated. The calculations having been based as indicated in (*iv*) there will be ample margin for the imports of specialities from Empire Countries.

18. The present spindleage in India as indicated earlier, is about 50,000 woolen and 37,500 worsted. However, the spinning plants working are mainly suitable for the heavier counts of yarn. Few details are given by applicants in their applications for capitals goods registration and hence it is not possible to arrive at a correct figure of the total spindleage registered, and therefore only a very rough estimate can be made and this approximates to about 32,000 woollen and 66,000 worsted spindles. This would mean an increase of 60% in woollen spindles and about 176% in worsted spindles. Before the war very few mills, if any, in the country worked doble shift. In any case they did not work double shifts all the year round. It is anticipated that from now on these mills will stick to the double shift working as they have been doing since the outbreak of the war. This would mean a very much greater internal production in future compared to pre-war. The additional spindles that have now already been registered would give a production which, combined with the production of the existing mills, would exceed

the target figure. It is therefore felt that if further increases in spindleage are allowed, the industry might suffer on account of over-production and instead of putting itself in a healthy condition might reduce it to the condition of part-time working, as most mills used to do pre-war. No licences for further imports of woollen-worsted machinery may be allowed except where such are in rehabilitation or balancing of existing mills. Exceptions may also be necessary (*a*) where the new licencees seek to import further plants in correction of the rough estimates on which their initial applications were made, and (*b*) for the establishment by the Provincial and State Governments of (*i*) demonstration factories in wool producing areas, and (*ii*) of spinning and finishing units for helping cottage weavers. The industry would be well advised to concentrate on the following types of goods :—

1. Cheap blankets and rugs of the Continental type using blends containing processed wools.
2. Tweeds and allied fabrics of the cheaper varieties.
3. Light weight worsteds.
4. Mixture cloths and tropicals.

As stated above no estimate is possible of the number of fine count woollen and worsted spindles on order. But as there is a definite demand for the lighter weight materials, licenses should be advised to modify their orders accordingly wherever this is possible. Tropical suitings, especially mixtures of cotton and staple fibres are likely to be in greater demand along with lighter worsteds like Yorkshire suitings, dress materials and shirtings. In considering imports of new machinery, emphasis should be laid on this aspect of production.

It is considered desirable that the manufacture of woollen machinery, at least the essential spares, should be established in this country. A consideration of this question should be taken along with the similar proposition relative to the cotton textile industry, as the volume of work in connection with the manufacture of woollen machinery may not justify the establishment of a separate plant. However, such a plant laid out for the manufacture of cotton textile machinery could easily turn out woollen machinery and spares.

19. When the war demands on the Indian woollen mills were increasingly reduced in 1944/45/46, the Industries and Civil Supplies Department of the Government placed complementary orders for woollen goods which were distributed in the civilian market as controlled woollen goods. This scheme of Government trading is understood to have definitely left in the hands of Government a not inconsiderable surplus. Normally, this surplus would have accrued to the Industry in the shape of additional

profits. The Industry strongly feels that it has a right to call upon Government to utilise the surplus for the Industry's benefit. Informal consultations seem to have been held between the Government and the Federation of Woollen Manufacturers as to the method of proper utilisation of the surplus. No better use could be made of the moneys than by the establishment of a Central Technological Institute for research on wool and products made out of wools. Such an Institute might either function independently or be attached to an Institute dealing with research on cotton and cotton goods. Regional Institutes may be necessary at places like Cawnpore and Amritsar, if the Central Institute is located at Bombay. The establishment of schools for training of technicians in the woollen line is also recommended. Without an adequate flow of trained technicians the expansion contemplated by the Woollen Industry may be stultified. It may be mentioned that no specialised training for woollen technicians is at present available in the country in any existing institution.

(*i*) In order to ensure availability of key personnel in the near future, it is strongly recommended that arrangements be made for training abroad of the following numbers of the foreman type in the various branches indicated :—

	Branch of training.	No, of individual.	Place of training.
1.	Sorting.	5	Bradford Technical Institute.
2.	Blending with special reference to short staple and reclaimed wools, carding and spinning.	10	Leeds, Dewsbury, Batley. Huddersfield Technical School.
3.	Wool scouring, worsted carding combing drawing and spinning, including combing drawing and spinning on the Continental system.	10	Bradford Technical Institute.
4.	Weaving and designing.	10	Huddersfield Technical School.
5.	Dyeing and Finishing.	10	Leeds.

The above programme of training is to be completed within the next five years; but, if this is at all possible, the entire lot may be sent abroad in the first two years. Emphasis should be laid on securing facilities for

apprenticeship training for these men in woollen mills in England. It is felt that mills in India would be prepared to take up properly trained young men in their services and that the mills might be prepared to share training expenses of these young men more particularly premia charged in the actual practical training in running concerns in England. The scheme of training should therefore take the shape of a modified Bevin Training Scheme. Existing mills and new licensees should be circularised to ascertain the measure of co-operation they are prepared to extend in this behalf.

(*ii*) *Technicians.* The Government of India are already considering the advisability of getting some German technicians and have circularised the mills asking them if they need the services of any. It would be equally well advisable to consider importing some Italian woollen technicians also. In the pre-war period the Italians were able to manufacture and to export to India types of woollens for which there was a progressively increasing demand. It is expected that the demand for this class of goods will be very substantial during the next five years also.

20. The implementation of the various recommendations in this report will need a specialist staff with the Central Government. It is suggested that a Development Officer with competent technical assistance be entertained as part of the Industries Department. Such an office could go into questions of co-ordination, questions of assistance to the Industry, and of maintaining commercial and propaganda services for Indian woollen goods in the Near East markets.

21. So far no attempt has been made by the Industry or by the Government to send out a deputation to places like Australia, the Continent, England and the U. S. A. A deputation of this nature would have served an extremely useful purpose both with regard to determining the availability of raw materials (wools and artificial fibres) and the fixing up of prices and suitable delivery periods for machinery needed in the country. It will still be advisable to send out such a deputation. The data this deputation will be able to collect and the contacts it will be able to establish will be extremely useful to the Industry.

At the moment the Industry is facing great difficulty in the matter of securing merino wools and tops from Australia. A deputation of this nature could go into this question and fix up an arrangement with the Government of Australia as also with the Manufacturers and Exporters in Australia, where-by the Industry would be able to get regular and adequate supplies of the wools it requires and at reasonable prices. The deputation could also make a recommendation to the Government for including in trade agreements that the Government might make

with the Government of Australia any working arrangements that the deputation might arrive at with Governmental and other Bodies in Australia as regards supply of wool to India.

22. *Tariff.* At present all the wools and tops required by the Indian Industry and which are imported from abroad are allowed duty free and it is hoped that this position will subsist. The recommendations made in this report have laid stress on the production of mixture goods and the mixing of artificial fibres like Fibro, Ardil, Rayolanda etc. for the production of light weight suitings. At present there is a fairly heavy duty on the import of such artificial fibres into the country and this makes the use of these fibres uneconomic. If this duty is allowed to remain it will be very difficult for the Industry to make increasing use of such fibres. These fibres will as a matter of fact play a very important part in the development of the Woollen Industry in future and could be classified as 'important semi-processed raw materials urgently needed for use by the Industry.' In view of the policy of the Government of India as expressed by the Hon'ble the Finance Member in his budget speech of February 1946, it is recommended that artificial fibre tops for use in blending with wools be exempt from duty.

(*ii*) There is at present a revenue duty on imported woollen goods. It is felt that the rate of this duty should not be lowered to the disadvantage of Indian industry. Indian Industry will need help and protection for a long time for various reasons. The old established mills worked day and night during the war without being able to keep their plants in proper condition because of the difficulty in getting spares. They will now have to go in for extremely heavy expenditure both with regard to getting over this deficiency and with regard to altering their plant and adding sections to it in the light of recommendations made in this report. The new licensees will have to start their mills with machinery bought at high prices. Both the old and the new mills would therefore require all the help and protection that the Government can give them. As a first step in this direction it is recommended that the existing import duty on woollens be not lowered.

(*iii*) The Hon'ble the Finance Member also indicated in his budget speech that Government would consider the reduction or exemption from import duty of industrial machinery. It is very strongly urged that as a measure of countervailing aid to the Indian Woollen Industry, the effect of the high prices at which new machinery is ordered from abroad be mitigated to some extent by the exemption of such machinery from the payment of import duty. Governmental action in this regard

should be taken in the near future if the benefit is to accrue to machinery which is on its way to this country.

23. Another important matter to which attention should be drawn is the subject of making available surplus structural material, transport vehicles and workshop and power equipment in the hands of the Disposals Directorate. It is the declared policy of the Disposals Board to ensure the movement of surplus war stores direct to the users at reasonable prices. The existing woollen mills as well as those newly licensed should be notified to offer bids for their requirements of the foregoing types of stores before such stores are disposed of by public auction or otherwise. To the extent that Industry is able to get these materials at reasonable prices the Industry will be enabled to market its goods cheaply and to compete on favourable ground in external markets.

IV COTTAGE WOOLLEN INDUSTRY.

24. The Cottage Woollen Industry in India is a fairly important one and deserves to be preserved in the post-war period by State aid, if need be. Not long ago the cottage industry supplied large quantities of cloth in Northern India which is the main market for woollen fabrics. But gradually due to change of fashions and competition from shoddy fabrics imported from Italy and Poland, the handloom weavers had to confine themselves largely to the production of coarse blankets (kamblis) for which there was a demand from the poorer classes. At the outbreak of this war there were approximately 1,00,000 handlooms in the United Provinces, the Punjab, Jammu and Kashmir and Hyderabad and in parts of Mysore, but since their range of production was limited they had to struggle hard. The war created a large demand for blankets and other woollen materials which the mill industry could not cope with on its own, and the Supply Department diverted part of the demand to the handloom woollen industry The orders from the Supply Department and the increased demand from the civilian market for blankets, tweeds, rugs, etc., due to cessation of imports from Italy and other countries came to the rescue of the handloom industry. But as the orders from the Supply Department have now almost ceased and the civilian market is expected on the restoration of normal conditions to return to shoddy and other cheap imported fabrics, the handloom industry will, unless timely steps are taken to enable it to withstand the competition in the post-war preiod, be confronted with the same difficulties as before.

25. A question which naturally arises at this stage is what steps are necessary to ensure the prosperity of the handloom woollen industry after the war. Broadly speaking, the difficulties confronting this industry are (i) lack of facilities for the purchase of raw materials, up to date

equipment, etc., (*ii*) lack of finishing and marketing facilities ; (*iii*) lack of standardization of the products of the industry ;and (*iv*) absence of adequate technical guidance and finance. On account of their impecunious circumstances the handloom weavers are unable to buy the raw materials to their best advantage or use up to date equipment. Further due to lack of knowledge of market tastes they often manufacture materials which are not in vogue and are compelled to sell them at whatever price they can get. Proper finishing of woollen fabrics is the key to successful marketing ; but since the handloom weavers cannot afford to instal expensive finishing machinery they have to sell their goods unfinished or hand finished at unfavourable rates. Generally speaking, all these difficulties are of a type which can be overcome by collective effort. Should the intensive organisation of the cottage industry on co-operative basis be not possible, the Provincial and State Departments of Industries could help to a great extent by establishing carding, designing and dyeing and finishing centres. In this connection it is worthy of note that in order to obtain their heavy requirements of blankets and other woollen materials the Supply Department successfully organised the wool weaver in the United Province, the Punjab and some States under their respective Departments of Industries and drew satisfactory supplies from these sources.

26. Some of the functions to be performed by an organisation of the kind proposed, would be (*i*) to purchase raw materials and sell them to the weavers at favourable rates ; (*ii*) to maintain technical staff and designing sections at important wool weaving centres in order to keep the technique of the weavers up to date ; (*iii*) to start finishing stations equipped with modern plant and machinery for finishing the fabrics produced on handloom ; and (*iv*) to have sale depots for the disposal of the finished handloom goods. It is possible that at the outset the proposed organisation may not prove to be self-supporting ; so, it could receive a subvention from the State.

27. Wherever the cottage industry has held its own so far, it has been on account of the fact that it produced goods like kamblis and puttoo cloth which are distributed and consumed within a limited radius of the centre of manufacture. The economy of most of this manufacture was attributable to the fact that the producer used his own goods for a cold season and thereafter sold his wares to a middle man. The cost factor, therefore, did not loom in this type of small scale industry. This section will continue to exist howsoever strongly it may be assailed by mill made goods. The same cannot be said of the cottage woollen tweed and rug industry which prospered during the war period as a result

of scarcity and of high prices. It is felt that this branch of the cottage industry can only survive if it turns its attention to the production of exclusive lines of woollen goods, in other words prestige products. The raw material for this class of goods exists in the country in the shape of fine Bikaner and Joria wools and of Pashmina.

Attempts should be made to assist this Industry with two types of plants—one for producing specially blended wools for the production of exclusive lines of goods, and the other of the normal type capable of supplying yarns to cottage weavers where hand-spun yarns in suitable qualities at reasonable price are not available. It is strongly recommended that the Industries Department of the Central Government should erect demonstration unit under the control of its Wool Development Officer. Delhi would be a suitable location for this plant, as Panipat and Muzaffarnagar, the two big centres of the Punjab and U. P. Woollen Cottage Industry are within easy reach. It is confidently expected that weavers from these two centres and perhaps also from Amritsar will visit the demonstration unit for the purpose of training.

V. SUGGESTIONS FOR IMPROVING INDIGENOUS WOOLS.

28. The marketing of indigenous raw wools has all along been very defective in India. The village producers and Beoparies have little interest in washing and shearing the sheep properly or grading wool before disposal. The Beopari after purchasing the wool in mixed and ungraded lots passes it on to the dealers, consumers and shippers without proper preparation. Shearing of dirty wool without washing, and mixing of body wools with skirtings render it uneconomical for processing. On the top of it adulteration is widely practised by merchants which reacts against the producer. Unless it is possible to obtain properly graded clean and skirted wool from the producers and Beoparies, it would be difficult to encourage the greater use of Indian wools by the Woollen Industry. During 1939/40 experimental shearing and rough grading of wool was carried out at Nagore and Pali, the two important wool producing centres in Jodhpur State, by the Economic Development Department of the State in collaboration with the Agricultural Marketing Adviser to the Government of India. In the Spring and Autumn Clips of 1940, 2, 345 and 1,672 sheep respectively were washed and shorn. Out of the Spring Clip of 1940, 7 bales of wool (300 lbs.each) were sent to the Wool Controller, Liverpool, through the High Commissioner for India in London for evaluation and sale. Though this wool was shown in the Price Control Schedule as "Marwar White" the price fixed for it being 15 pence per lb. c. i. f. a British Port, the washed and sorted worsted wool from the State as appraised by the Wool

Controller obtained an average value of 19-1/7 pence per lb. The importance of washing wool before shearing and grading before marketing cannot be overstressed. It is suggested that in the wool producing centres adequate scouring tanks be provided and all facilities afforded for washing of sheep before shearing. In fact it would be advantageous if by legislation sales of unwashed and ungraded wools be made illegal. Such an action was taken in case of hides and skins and proved very successful.

29. The breeding of sheep also requires development. The shepherds today pay no attention to this aspect with the result that the quality of Indian wools as also the yield per sheep has not noticeably improved. Experiments of crossbreeding with Australian Rams have been carried out in Hissar and other places and they proved very successful. No doubt due to climatic conditions it will never be possible to produce long staple wool in the plains ; however finer qualities in the short staples could be produced both by selective and crossbreeding. It is felt that the successful results of breeding experiments can and should now be applied on a commerical scale to lessen the dependence of India on imported raw wools.

30. Indian wool at present is mainly used in the manufacture of woollens e. g. Blankets, tweeds, and carpets as opposed to worsteds. In order to further increase the uses of Indian wools, it would be advantageous if at the main wool markets and industrial centres plants for manufacturing tops suitable for being spun on the worsted system and also plants for spinning worsted yarns without the use of combs are established. It may be necessary to encourage such ventures with a subsidy on the product. Worsted yarns made out of Indian wools should find a very ready market with the high quality carpet manufacturers and the cheap hosiery and serge manufacturers. At present only imported crossbred and merino wools are used for worsted spinning in India. The suggestion made above will enable the use of Indian wools also for such spinning.

VI CARPET INDUSTRY.

31. The Carpet Industry in India dates back to the early Moghul period. The first factory was established at Lahore and later on the Industry was developed in other parts of the country and went down as far south as Warrangal in Hyderabad. Details of the development of the Industry are not fully available but some of the earlier products are prized as antiques and rank amongst the finest that the world ever produced. In the last century the industry witnessed a great set back and it was not till the attention of the European and the American Markets was directed to the Indian carpets that the industry was resuscitated and started reviving again.

32. In a way the Industry plays a very important part in the economy of the country. When the demand for carpets is normal the industry is responsible for working 8000 to 10000 looms and gives employment directly to about 30,000 to 40,000 workers and is able to utilise a very large quan.ity of local wools both in the form of hand spun and machine spun yarns. Considering that a carpet loom employs on an average of 3 to 4 men per loom for weaving along and a yard of carpet uses on an average about 4 times the yarn that an ordinary handloom fabric uses, the number of men directly employed and the amount of wool used are equivalent to men employed and yarn used on about 30000 to 40000 ordinary hand looms. The principal centres of the industry are Kashmir, Amritsar, Agra, Gwalior and Jaipur for the better class of carpets, Mirzapur and Bhadoi for the medium and cheap class of corpets, Bangalore and other places in the south for druggets. In view of the number of men the industry employs and the large amount of indigenous wools that it utilizes, it is desirable that the industry should be encouraged as much as possible.

33 As the industry deals in what one might call luxury goods in the main, it is subject to great fluctuations in demand. The local demand in the country can absorb only about 10%of the production and the industry relies to a great extent on being able to export its products outside India. The markets for these products are the U. S. A., Great Britain and other Empire countries. The Industry has to compete in the main with products from Persia and China and in normal times it is difficult for it to do so, because of the comparatively lower costs of production in those two countries. The products of the Industry can in the matter of quality compete successfully with those of any other parts of the world.

34. Practically all the better class of carpets are made in factories run by old established firms. These firms keep themselves in touch with world trends and modify and alter their designs and qualities suitably to enable them to export the products on a competitive basis. Most of the cheaper class of carpets, notably in Mirzapur and Bhadoi districts are however produced on the cottage industry basis. In normal times these districts work from 4000 to 5000 looms. At the moment there is a great demand for carpet all over the world and the industry is barely able to cope with a fraction of this demand. These conditions, it is anticipated, would continue only for a limited period and it is feared that competition from China and Persia might seriously affect the India industry.

35. Before the war the U. K. used to be a great buyer of Indian carpets. The tariff preference the Indian carpets enjoyed over carpets from Persia and China greatly helped t ncrease the volume of trade. At pre-

sent because of restrictions on sales and price limits etc., in the U. K. the export to that country is not as great as the export to the U. S. A. and to the other Empire countries. It is hoped that these restrictions will be considerably modified and the U. K. would be able to absorb the quantities or very near the quantities that she used to import before the war.

36. The wages of carpet weavers have gone up three to five times as compared with wages prevailing pre-war and Indian wools have also suddenly gone up considerably in price. Both these factors are responsible for a great increase in the cost of production of carpets in the country and it is feared that these factors might in the near future militate against their popularity in the foreign markets. If the carpet production drops it will adversely affect the Indian Woollen Industry which depends largely on the Carpet Industry for the absorption of a good proportion of heavy and coarse woollen yarns produced by it. The price factor plays a very great part in the local demand. If low priced carpets could be produced in the country, it is anticipated, the demand would increase. This cheapness cannot, however, be effected in hand made carpets beyond a certain limit. If a plan of cheapening costs is pursued it will ultimately react against the wages payable to the weavers. In order to sustain the demand for Indian wools and yarns that the carpet industry is capable of consuming, it is suggested that attempts should be made to encourage the manufacture of machine made carpets in the country. These carpets being cheaper than hand made carpets will supply the demand for cheap and yet attractive floor coverings in the country. Germany and the United States of America specialise in certain types of machinery for the production of machine made carpets and it is recommended that facilities be given to people (willing to import equipment for making machine made carpets) to import machinery from abroad.

Before the war about 1½ lakh lbs. of machine made carpets were imported annually into the country mainly because of their cheapness. This demand is bound to increase. The establishment of machine made carpets industry in the country will be able to supply this demand successfully. It will also be able to export machine made carpets to the neighbouring countries. India is very fortunately placed with regard to the production of machine made carpets in as much as she has all the raw materials wool, cotton and jute in the country. Certain types of Indian wools are in very large demand in all the countries where machine made carpets are made and there is no reason why a start should not be made here. Machine made carpets may find a local market but only from those customers who cannot afford even the cheapest types of hand made carpets, The main demand for these carpets will be from outside

India. Thc establishment of this industy will in fact supplement and not compete with the demand for hand made carpets, and if properly organized will open a very useful vista for a considerable volume of exports.

37. The table of exports of carpets appended to this note (Annexure III) will give an idea of the trend of the exports to countries in the British Empire and to other countries. The exports to the U. S. A. were at their peak round about 1927-28 and show a progressive decline since then. This was mainly due to competition from Persia and China.

38. It would be a great help to the hand made carpet industry if in any trade talks with the various importing countries sufficient stress is laid on the fact that no discriminatory legislation is passed against carpets exported from this country.

39. The preference that Great Britain and the Empire countries extended to carpets from India enabled India to increase her exports progressively to these countries. If this preference disappear it might react against the possibility of reaching pre-war figures of export to the U. K. It would therefore be desirable to try to retain these at least with regard to handloom carpets.

VII. SUMMARY OF RECOMMENDATIONS

I. In regard to the Woollen Textile Industry it has been recommended in the body of the Report that ;

(*i*) The Mills would be well advised to group themselves into one or the other of the two existing Federations.

(*ii*) The location of the woollen mills, existing and proposed new ones, are on rational lines.

(*iii*) In view of recommended targets for the first post-war quinquennium which can be satisfied by existing plant and by new plant already licensed, no further licences to new parties for imports of woollen worsted machinery be issued ; new licences should hereafter be confined to existing woollen mills seeking to rehabilitate or balance their plant or substitute fine count spinning for existing heavy counts.

(*iv*) Steps should be taken to establish a Woollen Textile Research Institute.

(*v*) Arrangements should be made for training both in India and abroad woollen technicians.

(*vi*) Raw wool and tops should be exempt from levy of customs as at present and similar exemption should be granted on artificial fibres used for blending with wool ; and

(*vii*) Woollen machinery should be admitted duty free.

II. In regard to the Cottage Woollen Industry it has been recommended that:—

(*i*) The organisational aspect should receive vigorous attention ; and

(*ii*) A demonstration Centre equipped with a small plant for producing high quality woollen textiles should be established at Delhi.

III. Suggestions have also been made for improving the production of indigenous raw wool and for encouraging the greater use of such wools wherever suitable for spinning worsted yarns.

IV. In addition to recommending certain measures for the stabilization of the Indian Carpet Industry, it has also been suggested that India should go in for the cheaper types of machine made carpets.

V. Finally, it has been recommended that a Woollen Development Section in charge of technically competent personnel should be established as part of the Industries Department.

ANNEXURE I.

Note on the current position of the Woollen Handloom Industry (vide para 6 of the Report).

I

Following the suggestion made by the Woollen Tariff Board, 1934-35, that the small scale Woollen Industry needed technical advice and assistance, the Government of India sanctioned a grant of Rs. 5 lacs spread over five years. Reports have been received from most of the Provinces interested in woollen production regarding the progress made with the use of the Central grant supplemented by local grants and the salient points in these reports are summarised below.

United Provinces. Along with the Punjab, this province played an important part in the supply of army blankets and blanketting cloth to the Defence Services in the Second World War (1939-45). The manual spinners and handloom weavers employed on this job were departmentally controlled by the Industries Department of the U.P. Government from two centres, Muzaffarnagar in the west and Badohi in the east. The war over, the Industries Department has now reverted to the two schemes with which it originally started with the help of the Central Government's Grant. These two schemes are known as the Almora-Naini Tal and the Garwal-Najibabad Wool Schemes with their headquarters at Almora and Pavri respectively. For the first of these schemes a recurring annual expenditure of Rs. 1, 35, 000 has been provided. The scheme includes a workshop and training centre at Almora where subsidised instruction in spinning, weaving and dyeing will be given in two standards, primary and advanced. Provision is made for the purchase and distribution of wool by Government to village work centres and for the collection of spun yarn. It is proposed to manufacture in a centre at Almora woollen goods worth Rs.1,00,000 annually consisting of tweeds, pashminas, knitted goods, blankets and namdahs. The second scheme has a similar budget and also aims at a similar output. The key centre will be Nujibabad where there is a finishing plant. Weaving will also be centralised here. Treadle charkas for spinning hill wools have been tried in the Kumaon and as the results are encouraging it is proposed to manufacture and supply such charkas on an extended scale. It will be noticed that in both the schemes it is only spinning that will be dispersed through the villages, while weaving and finishing will be in departmentally run establishments.

Marketing of products will be through the meduim of U.P. Government's emporia and authorised agents outside the Proviuce. In addition to these Government controlled aspects of woollen productions, the U,P. Government will also assist by 'co-operatives' woollen weavers working on their own.

The Punjab. This Province was also drawn upon extensively by the Defence Services for supplies of army blankets and blanketting cloth during the war, 1939-45. The activities of the Department of Industries were based on two milling and finishing centres at Paniput and Amritsar. With the cessation of the war the Punjab Government propose to retain only the centre at Panipat. Spinning and weaving centres will be extended to the Kulu Valley. 'Co-operatives' will be strengthened throughout the provices where woollen spinners and weavers are in concentration.

Assam. No departmental scheme has so far been launched by the Province for the improvement of the Wollen Industry.

Bihar. The Industries' Department of this Province conducts a Wool Weaving Institute at Gaya. There is also a Wool Weaving Demonstration Party consisting of one supervisor stationed at Gaya and four Wool Weaving mistries stationed at important wool centres in the province. The function of this party is to introduce improved blanket looms among the Ganderies to weave blankets in one width instead of in small patties. This party has so far introduced 600 wide-width blanket looms in the province. Recently these parties have also organised spinners to whom machine carded Tibetan Wool is issued. There is also a Government Wool Emporium at Gaya to facilitate the marketing of hand-loom weavers, products. The current annual expenditure is Rs.2.40,000.

The Bihar Government propose to establish two Wool Technological Institutes and three more Wool Weaving Demonstration Factories. The capital expenditure on these new proposals will be Rs.2,90,000 and the annual recurring expenditure Rs.1,14,000.

Central Provinces. Under the Central Governments subvention scheme, three demonstration parties were arranged under a Wool Assistant who gave lessons on the weaving of Kamblis on fly-shuttle looms. Spinning demonstrations on improved charkas were also given. All the yarn was spun from indigenous wool available in the Province itself. A woollen Co-operative has been formed with a working capital of Rs. 10,000 advanced by the Provincial Government. It is now proposed to establish a Central Wool Emporium which in addition to marketing the hand-loom products will also buy raw wool from shepherds, grade it and sell direct to spinners.

Madras. This province organised with Central assistance six Kambli Weavers Co-operative Societies in the Kambli weaving areas and one society for pile carpet weavers at Ellore. The societies finance members during the shearing season for the purchase of wool and take back from them the finished goods manufactured. The Provincial Co-operative Marketing Society at Madra undertakes the marketing. The Ellore Pile Carpet Weavers' Co-operative Society manufactures carpets of Moghul, Persian and Modern designs. There is a good demand for these carpets in India and foreign countries. This society is not experiencing any difficulty in marketing its finished goods. There is a dye-house attached to this society. In order to augment production and cope with the demand for its goods, the society proposes to establish a factory to accommodate about 35 pile carpet looms. The annual turn-over of all the seven Woollen Co-operatives is over Rs. 100,000.

Bombay. Two Governmental plants for milling and finishing hand-loom woollens were established at Hubli and Ahmadnagar. A wool Expert is in charge. There are three peripatetic demonstration parties whose main effort is to introduce fly-shuttle looms and one weaving school. The value of sales is Rs.2,90,000 mainly blankets and the number of weaver's families engaged is 3000.

Bengal. For the improvement of the Wool Industry, this Province has two wool weaving demonstration parties for imparting training in spinning, dyeing and weaving. No local spinning on any large scale is done and the weavers are mainly dependent on yarn imported into the Province. 2000 weavers are employed.

Sind. The Woollen Industry in Sind is mostly confined to the desert areas viz., Tharparkar District where there are about 500 weavers. Two demonstration parties are working under a Wool Expert. The whole area where the woollen industry exists is extremely thinly populated, there being very few villages which can boast of 6-7 looms. Naturally the process of improvement is slow. The annual production of woollen goods is about Rs. 50,000.

Orissa. Wool weaving and spinning do not exist in Orissa at present ; but there are possibilities of introducing these industries in Orissa. With this objest in view, two wool weaving mistries were appointed two years ago through whose efforts 500 army blankets were woven by weavers of Orissa by importing woollen yarn from the United Provinces and Bihar. The Provincial Government have recently sanctioned a scheme for a wool weaving demonstration party in Orissa for two years from 1.4.46. The party will consist of two instructors and one clerk. The two instructors will be posted in two different centres where they will distribute wool to the villagers and teach them

the method of carding, spinning and weaving wool and take delivery of finished goods on payment of fixed wages. It is also contemplated to appoint one expert shearer in each of the six districts of the province to assist and educate the owners of sheep breeding units and shepherds in washing, shearing and dipping of sheep and proper handling of wool.

II

The subvention of the Government of India was not extended to the Indian States for constitutional considerations. However some of these States have a woollen handloom industry of some magnitude. Reports have been received from Mysore and Jodhpore which are summarised below.

Mysore. Kumbli making is the hereditary occupation of the Kumbar Caste. There are about 8000 families engaged in this industry in the State. Though the industry is in existence in practically every district of the State, nearly 85% of the total of 8000 looms are concentrated in Tumkur, Chitaldrug, Mysore, Mandya and Kolar districts. The prewar production figures of Kamblis are 850,000 pieces annually, consuming 2,500 lbs. of wool and valued at Rs.13,00,000.

The manufacture of pile carpets and druggets is another important branch of the woollen industry in the State employing 1000 families. Carpet making is the hereditary occupation of the " Sewrashtra " sect. This industry is almost localised in and round about Bangalore City. The value of carpets and druggets exported from the State fluctuated prewar between Rs.10 and 20 lacs per annum. 90% of the carpets and druggets are exported. The druggets go mostly to the U.K. and the U.S.A. This branch of the industry is thriving better than the Kambli branch and the number of carpet looms is on the increase.

The Mysore Government opened a wool spinning and weaving centre at Kolar in 1938 to serve as a demonstration unit. Arrangements have been made to distribute improved charkas and fly-shuttle wide-width looms. There is a similar unit at Chitaldrug. The Government proposes to open a central carding and finishing factory at a capital cost of Rs.4 lacs in the Hasan district.

Jodhpur. This is primarily a wool producing state exporting about a lac of mounds annually to Liverpool prewar. The State concentrates on measures to improve the quality of raw wool. During the war the State undertook large orders for the supply of army blankets. The normal peace-time production is blankets and felt.

ANNEXURE II

Details of spindleage and loomage of Indian Woollen Industry

(*Vide* para. 10 of the Report)

	Spindles			
	Woollen.	Worested	Powerlooms.	Handlooms
1. Cawnpore Woollen Mills, Cawnpore. ...	7776	9536	355	172
2. New Egerton Woollen Mills, Dhariwal. ...	8640	6420	328	68
3. Oriental Carpet Manufacturers (India), Ltd., Amritsar. ...	4101	...	52	...
4. Raymond Woollen Mills, Ltd., Bombay. ...	2880	10400	196	...
5. Indian Woollen Mills, Ltd., Bombay. ...	3000	4020	128	...
6. Ahmad Abdul Karim Bros, Bombay. ...	...	4480	84	...
7. Shri Karan Singh Woollen Mills, Ltd., Srinagar. ...	2040	960	18	94
8. E. Sefton & Co., Ltd., Mirzapur. ...	1276		...	51
9. J. K. Woollen Mills, Cawnpore. ...	2400		62	...
10. B. K. Subbayah & Sons, Bangalore City. ...	742		10	...
11. Bangalore Woollen Mills, Ltd., Bangalore City. ...	6471		131	...
12. Krishna Woollen Mills, Bombay. ...				15
13. Allahabad Woollen Mills, Allahabad. ...	264		3	22
14. Eastern Woollen Mills, Bombay. ...	1680		32	...
15 Shri Dinesh Mills, Ltd., Baroda. ...	3040		50	...
16. Nagpal Woollen Mills, Bombay. ...		1664	...	...
17. United Woollen Mills, Amritsar. ...	270		...	11
18. Raj Spinning Mills, Amritsar. ...	1800		...	40
19. India Woollen and Textile Mills, Amritsar.	1300		52	43
20. Small Scale Industry in Amritsar and elsewhere. ...	2300	...	800	(no reliable figures)

ANNEXURE III

(Vide para. 37 of the Report)

Total values and quantities of Exports of Woollen Carpets and flour rugs

(Values in thousands of rupees and quantities in thousands of lbs.)

Countries	1929-30	1930-31	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37	1937-38	1938-39
U. K.	3825	4062	4062	4462	5549	7391	6032	6560	7620	6124
	(2603)*	(2719)	(3537)	(4283)	(67.10)	(8235)	(7034)	(7487)	(8374)	(7219)
Canada	222	295	117	112	288	404	331	430	730	706
	(60.1)	(92.1)	(44.9)	(54.7)	(167)	(230)	(171)	(288)	(407)	(413)
Australia	153	32.4	19.7	73.3	55.2	96.0	154	100	109	116
	(104)	(19.3)	(17.7)	(65.7)	(53.4)	(101)	(173)	(118)	(107)	(137)
Java	111	106	69.7	74.0	86.4	49.0	46.2	61.5	48.3	119
	(115)	(109)	(74.4)	(80.8)	(108)	(61.3)	(56.1)	(88.3)	(66.1)	(156)
U. S. A.	3603	2092	1087	1270	849	782	1310	1196	1383	714
	(1127)	(840)	(554)	(928)	(775)	(858)	(1621)	(1574)	(1785)	(655)
Ceylon	200	148	178	197	190	1	68.3	53.3	30.0	31.7
	(419)	(339)	(443)	(468)	(519)	(513)	(163)	(173)	(53.1)	(65.4)
Total	8502	6704	5673	6350	7267	8981	8065	8564	10247	8156
	(4636)	(4232)	(4767)	(5963)	(8452)	(10093)	(9347)	(9898)	(11061)	(8945)

*Figures within brackets indicate quantities in lbs. (000).

STATEMENT I

Imports of worsted yarn for weaving

	QUANTITY IN (lbs.)						VALUE IN (Rs.)					
	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41
United Kingdom (including Channel islands) ...	35,762	5,568	32,257	36,696	9,379	5,130	56,068	11,382	66,706	67,044	15,964	14,718
Poland (including Danzing) ...	93,915	20,936	44,971	334,815	66,126	...	1,62,214	40,787	1,09,513	6,04,543	1,00,820	...
Germany ...	...	...	353	4,716	...	...	...	...	2,055	10,209	...	...
France ...	300	...	...	10,153	...	...	1,795	...	...	19,396	...	...
Czechoslovakia...	...	...	11,828	796	...	...	...	...	22,693	1,670	...	...
Japan ...	9,55,696	924,301	1,539,741	1,773,250	1,650,981	1,229,443	16,06,072	17,81,246	35,92,207	31,24,989	29,04,906	31,52,506
Italy (including Fiume) ...	524	...	...	...	...	...	427	...	...	...	...	...
TOTAL FOREIGN COUNTRIES	1,050,435	945,237	1,596,893	2,123,730	1,717,107	1,229,443	17,70,508	18,22,033	37,26,468	37,60,807	30,05,726	31,52,506
Share of Bengal...	100,608	67,647	95,740	30,752	12,080	14,600	1,7 ',543	1,16,909	2,16,246	58,673	23,466	37,550
„ „ Bombay	183,897	249,583	752,980	690,181	618,340	749,596	2,98,500	4,75,445	17,26,948	12,58,877	11,24,715	19,68,516
„ „ Sind ...	794,405	627,338	775,457	1,416,271	1,090,926	468,423	13,40,091	12,26,801	18,40,845	24,64,962	18,64,751	11,54,403
„ „ Madras	7,287	5,537	4,973	23,222	5,140	1,954	13,442	12,722	9,135	49,339	48,754	8,756
„ Burma...	...	700	...	...	...	...	...	1,538	...	...	...	...
TOTAL ...	1,086,197	950,805	1,629,150	2,160,426	1,726,486	1,234,573	18,26,576	18,33,415	37,93,174	38,27,851	30,21,690	31,67,224

STATEMENT II

Imports of Knitting Wool

	QUANTITY (IN lbs.)						VALUE (In Rs.					
	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41
United Kingdom (including Channel Islands) ...	261,119	225,994	216,283	205,207	150,449	5,115,504	5,35,782	5,80,800	6,86,669	6,23,452	4,80,712	5,35,635
Other British possessions ...	62	176	108	17	1,490	904	145	424	284	51	3,897	3,310
Hongkong ...	37,763	...	...	...	...	...	31,601	...	...	...	...	...
TOTAL BRITISH EMPIRE ...	298,944	226,170	216,391	205,224	151,939	116,408	5,67,528	5,81,224	6,86,953	6,23,503	4,84,609	5,38,945
Poland (including Danzig) ...	6,122	8,962	16,459	57,216	...	...	6,042	18,524	36,618	1,09,275	...	...
Germany ...	16,245	40,625	17,585	18,775	6,074	...	54,662	59,310	62,918	53,427	17,743	...
Belgium ...	...	15,381	662	427	1.173	...	...	28,786	1,997	813	2,214	...
France ...	217	59	2	19,996	1,469	...	700	159	33	39,827	2,795	...
Czechoslovakia...	...	216	754	38,562	...	...	...	674	2,314	79,688	...	...
Japan ...	716,908	933,232	831,408	854,628	892,765	340,225	10,82,913	16,42,659	18,95,556	16,05,491	15,46,876	9,23,089
China (exclusive of Hongkong and Macao) ...	2	...	...	...	5,026	59,208	4	...	...	...	11,423	1,54,834
United States of America Via. Atlantic Coast...	15	...	112,968	4	...	...	15	...	2,38,215	34	...	1

STATEMENT II—(*contd.*)

	QUANTITY (IN lbs.)						VALUE (In Rs.)					
	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41
Other Foreign Countries ...	126	12	14	596	552	6	326	38	34	1,905	1,705	46
TOTAL FOREIGN COUNTRIES...	739,635	998,487	979,852	990,204	907,059	399,439	11,44,662	17,50,150	22,35,685	18,90,460	15,82,756	10,77,970
Share of Bengal...												
„ „ Bombay	137,129	98,216	190,738	102,335	78,654	96,712	2,67,008	2,62,801	5,19,245	2,99,674	2,25,498	3,42,170
„ „ Sind ...	238,066	438,507	374,287	495,020	491,454	174,574	3,64,045	7,81,806	8,95,671	9,65,736	9,35,404	5,52,352
„ „ Madras	40,020	45,168	58,855	42,711	27,882	15,859	87,477	85,946	1,18,594	91,977	57,791	46,929
„ „ Burma	78,529	60,623	...	...	...	...	1,43,271	1,21,704	...	...	...	...
TOTAL ...	1,038,579	1,224,657	1,196,243	1,195,428	1,058,998	515,847	17,12,190	23,31,374	29,22,638	25,13,963	20,67,365	16,16,915

STATEMENT III

Imports of Yarn and Knitting Wool of other sorts.

	QUANTITY IN (lbs.)						VALUE IN (Rs.)					
	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41
United Kingdom (including Channel islands) ...	...	2,356	64,394	33,759	87,596	72,102	...	3,358	1,09,908	50,782	1,29,933	1,72,151
Straits Settlements	...	...	...	...	38	...	...	...	...	...	90	...
TOTAL BRITISH EMPIRE ...	...	2,356	64,394	33,759	87,634	72,102	...	3,358	1,09,908	50,782	1,30,023	1,72,151
Czechoslovakia ...	...	...	...	5,548	...	...	...	...	...	7,555	...	...
Japan ...	...	...	1,154	1,799	24,446	4,500	...	...	2,506	3,351	40,003	12,787
China (exclusive of Hongkong and Macao) ...	...	5,400	...	...	...	...	...	8,373	...	...	...	...
Other Foreign Countries ...	...	219	267	112	...	11	...	276	946	255	...	93
Share of Bengal...	...	6,395	61,792	33,766	104,734	72,416	...	10,320	1,05,460	42,261	1,56,898	1,71,558
„ „ Bombay	...	926	3,011	5,256	784	175	...	1,051	5,522	8,340	1,725	545
„ „ Sind ...	...	340	...	400	1,688	...	...	408	...	450	3,245	...
„ „ Madras	...	2	1,012	1,796	4,874	3,977	...	3	2,378	3,892	8,158	12,928
„ „ Burma...	...	312	...	...	...	...	...	315	...	...	...	...
TOTAL ...	...	7,975	65,815	41,218	112,080	76,613	...	12,007	1,13,360	61,943	1,70,026	1,85,031

STATEMENT IV

Imports of worsts and rugs, including woollen blankets mixed with other materials but excluding floor rugs

	QUANTITY IN (lbs.)						VALUES (IN Rs.)					
	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41
United Kingdom (including Channel Islands) ...	59,540	31,176	36,118	36,349	31,752	24,937	97,540	63,898	88,577	90,863	81,332	73,001
Burma ...	...	...	1,977	4,387	1,924	92	...	...	671	5,049	917	640
Hongkong ...	1,455	2,960	1,976	2,320	1,140	203	2,611	6,080	70	29	77	174
Other British possession ...	3,600	613	939	183	112	4,966	21879	947	1,388	378	59	4,968
TOTAL BRITISH EMPIRE ...	64,595	34,749	39,110	40,939	33,958	30,198	1,03,030	70,925	90,706	96,319	82,385	78,783
Poland (including Danzing) ...	39,882	392,164	48,071	...	7,412	...	9,358	2,89,929	38,044	...	3,363	...
Germany ...	141,833	431,311	53,356	3,209	994	...	7,74,389	1,53,196	21,552	7,670	4,092	...
Belgium ...	21,661	6,216	25,965	33	...	...	9,594	6,434	16,248	39	...	...
Italy (including Fiume) ..	4,167,525	2,549,322	4,991,121	4,034,848	1,649,495	42,706	31,19,091	18,87,420	37,21,058	30,48,282	11,22,133	30,259

STATEMENT VI

Imports of Carpets and Flour Rugs

	QUANTITY (IN lbs.)						VALUES (IN Rs.)					
	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41
United Kingdom (including Channel Islands) ...	147,644	138,321	79,647	87,783	47,151	30,088	3,06,496	3,05,916	2,04,907	1,63,696	87,630	79,064
Bahrein Islands...	899	357	592	702	2,487	2,215	1,522	541	1,165	1,255	10,487	5,377
Ceylon (excluding Maldives)...	503	164	2,682	574	366	641	920	188	7,369	660	602	698
Burma ...	...	...	1,952	3,645	1,718	3,872	...	...	7,210	8,078	5,264	9,434
Straits Settlements	512	2,547	1,933	1,635	2,222	763	1,072	9,807	5,511	4,679	1,966	1,252
Other British Possessions ...	1,986	2,181	1,885	6,987	1,684	5,493	3,051	2,758	4,015	5,795	1,940	4,562
TOTAL BRITISH EMPIRE ...	151,444	143,570	88,691	101,326	55,628	43,072	3,13,061	3,19,210	2,30,177	1,84,163	1,07,889	1,00,387
Poland (including Danzing) ...	...	8,265	...	...	...	...	...	6,453	...	...	...	...
Belgium ...	11,661	9,175	18,223	9,635	1,363	...	10,420	10,157	25,770	13,030	1,762	...
France ...	1,231	1,218	1,251	3,339	9,308	1,445	1,624	848	2,044	7,057	11,292	2,028
Italy (including Fiume) ...	398	...	8,596	1,077	5,535	152	873	...	6,221	993	5,042	15
Turkey European	360	7,210	4,160	728	...	...	13,400	28,928	18,554	3,593	...	...

STATEMENT VI—(*contd.*)

	QUANTITY (IN lbs.)						VALUES (IN Rs.)					
	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41
Turkey Asiatic ...	...	...	10,008	...	...	...	...	...	54,067	...	...	...
Iraq ...	4,212	1,908	1,854	2,058	1,356	36,050	10,562	3,944	3,992	3,145	2,540	72,437
Iran ...	9,596	17,923	9,217	5,945	23,249	68,347	11,585	21,315	17,760	8,275	94,949	2,01,315
China (exclusive of Hongkong and Macao) ...	12,592	17,633	6,350	16,956	9,834	16,708	14,041	11,389	13,449	13,972	8,968	17,842
United States of America, Via. Atlantic Coast...	4,633	2,347	7,042	441	717	643	8,390	4,456	28,645	542	2,377	1,683
„ Pacific Coast...	...	192	28	12	2,657	104	...	210	29	4	1,135	130
Other Foreign Countries ...	5,415	3,436	1,822	2,267	2,734	1,193	8,053	6,165	4,118	7,514	3,585	2,675
TOTALFOREIGN COUNTRIE...	50,298	69,307	68,551	42,461	56,753	124,642	78,951	93,865	1,74,649	58,125	1,31,650	2,98,260
Share of Bengal...	51,502	59,440	47,780	65,860	43,973	32,743	98,799	94,106	1,09,647	1,11,882	68,016	60,310
„ „ Bombay	83,048	81,853	77,548	60,007	38,993	90,091	1,38,632	1,66,644	1,65,263	88,451	69,670	2,16,595
„ „ Sind ...	13,429	17,782	23,259	13,453	24,360	42,004	29,241	46,026	96,068	30,516	97,823	1,16,065
„ „ Madras	5,073	3,143	8,655	4,467	5,055	2,876	9,994	6,345	33,848	11,439	4,036	5,677
„ „ Burma...	48,690	59,659	...	...	...	...	1,15,346	99,954	...	...	...	...
TOTAL ...	201,742	212,877	157,242	14,3787	112,381	167,714	3,92,012	4,13,075	4,04,826	2,42,288	2,39,539	3,98,647

STATEMENT VIII

Imports of Goods of Wool mixed with other materials

	QUANTITY (IN Yards)						VALUES (IN Rs.)					
	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41
United Kingdom (including Channel Islands) ...	1,822,711	1,771,981	2,667,264	4,659,908	697,676	631,448	23,76,517	24,06,294	37,98,085	22,35,077	9,12,225	11,65,165
Burma ...	...	...	11,850	317	4.746	9,782	...	...	7,721	992	6,545	24,166
Other British Possessions ...	289	...	687	...	70	...	910	...	753	...	99	...
TOTAL BRITISH EMPIRE ...	1,823,000	1,771,981	2,679,801	1,660,225	702,492	641,230	23,77,427	24,06,294	38,06,559	22,36,069	9,20,869	11,89,331
Polnnd ...	117,008	60,707	98,666	68,227	38,218	...	1,83,958	85,144	1,79,443	1,28,470	56,382	...
Germany ...	54,349	47,587	38,230	27,040	9,924	...	1,03,539	1,27,131	1,17,820	86,809	36,096	...
Belgium ...	12,324	6,752	952	3,018	5,859	...	16,993	10,714	3,313	5,474	13,193	...
France ...	1,468	1,123	1,392	12,813	1,356	467	2,919	2,051	11,526	15,648	2,453	1,361
Italy (including Fiume) ...	112,801	15,118	153,616	214,223	176,225	3,610	86,260	12,729	2,29,017	3,18,309	2,48,099	7,117
Czechoslovakia ...	434	921	1,330	1,234	294	...	1,866	4,614	6,002	2,755	794	...
Iraq ...	11,481	173	11	...	2,025	...	4,584	387	30	...	5,061	...

SATATEMENT VIII—(*cont.*)

	QUANTITY (IN Yards)						VALES (IN Rs.)					
	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41
Japan ...	210,010	420,580	644,112	332,744	273,498	289,786	2,67,671	4,84,976	7,56,875	3,76,904	2,90,178	5,42,109
United States of America Via. Atlantic Coast ...	...	493	1,032	602	2,888	1,898	...	1,202	4,335	2,667	5,223	9,898
,, Pacific Coast	...	...	121	...	...	...	...	...	368	...	...	...
Other Foreign Countries ...	776	271	146	573	2,930	...	1,805	932	540	1,034	4,654	...
TOTALFOREIGN COUNTRIES...	520,651	553,725	939,608	660,481	513,117	295,761	6,69,594	7,29,880	12,99,269	9,37,970	6,62,133	5,60,485
Share of Bengal...	507,718	504,200	891,248	714,692	294,316	192,842	4,74,396	5,12,611	9,93,707	6,37,226	3,55,617	3,25,628
,, ,, Bombay	982,738	1,098,022	2,175,637	1,147,562	577,790	652,519	14,75,571	15,64,227	30,96,766	17,79,726	7,34,667	12,48,799
,, ,, Sind ...	475,517	340,902	530,969	444,009	331,120	84,879	5,91,745	5,46,552	9,76,670	7,32,353	4,70,569	1,58,369
,, ,, Madras	34,313	30,426	21,556	14,443	12,283	6,751	53,174	48,408	38,685	24,734	22,149	17,025
,, ,, Burma...	343,365	352,156	...	...	...	...	4,52,135	4,63,980	...	...	...	...
TOTAL Yds. ...	2,343,651	2,325,706	3,619,409	2,320,706	1,215,609	936,991	30,47,021	31,36,174	51,05,828	31,74,039	15,83,002	17,49,816
lbs. ...	1,431,742	1,416,964	2,142,001	1,372,067	721,312	567,107						

STATEMENT IX

Imports of Ruffle Cloth and Shawl Cloth

	QUANTITY (IN Yds.)						VALUES (IN Rs.)					
	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41
United Kingdom (including Chennel Islands) ...	28,535	898	...	...	...	...	15,931	333	...	...	...	...
Japan ...	133,416	...	8,690	590	4,137	...	1,08,712	...	8,656	385	3,108	...
France ...	57,972	...	...	...	...	...	40,107	...	...	...	...	...
China (exclusive Hongkong and Macao) ...	...	42,437	...	...	..	...	...	40,677	...	...	...	...
Other Foreign Countries ...	...	3,089	4,043	...	...	...	...	3,071	3,042	...	...	...
TOTALFOREIGN COUNTRIES...	191,388	45,526	12,733	590	4,137	...	1,48,819	43,748	11,998	385	3,108	...
Share of Bengal...	5,490	...	4,678	...	...	...	4,810	...	5,430	...	...	...
„ „ Bombay	35,703	7,828	...	...	...	...	28,893	7,703	...	...	...	...
„ „ Sind ...	178,730	38,596	8,055	590	4,137	...	1,31,047	36,778	6,658	385	3,108	...
TOTAL Yds. ...	219,923	46,424	12,733	590	4,137	...	1,64,750	44,081	11,998	385	3,108	...
TOTAL lbs. ...	87,287	19,392	3,923	213	1,496	...						

STATEMENT X
Roller Cloth Clearer Cloth and Sizing Flannel

	QUANTITY (IN Yds.)						VALUE (IN Rs.)					
	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41
United Kingdom (including Chennel Islands) ...	106,083	75,747	136,704	120,507	122,172	132,789	3,21,282	2,15,485	4,38,382	4,17,384	4,57,604	7,18,873
Germany ...	435	4	1,101	6,874	1,517	...	3,732	24	805	9,937	8,434	...
France ...	1,271	1,947	3,458	7,778	2,777	1,663	4,852	7,076	11,204	28,474	10,393	7,692
Austria ...	2,692	480	2,359	1,644	...	...	7,939	1,550	9,126	7,257	...	...
Japan ...	2,323	*	*	*	...	...	5,508	*	*	*	...	...
Other Foreign Countries ...	424	555	1,776	1,157	318	...	1,469	1,278	3,142	4,809	1,237	...
TOTALFOREIGN COUNTRIES...	7,145	2,986	8,694	17,453	4,612	1,663	23,500	9,928	24,277	50,477	20,064	7,692
Share of Bengal...	2,428	4,089	3,747	8,943	6,011	3,052	7,777	10,475	11,696	25,591	17,730	13,767
,, ,, Bombay	110,792	74,435	141,624	128.567	113,808	118,910	3,36,756	2,14,354	4,50,872	4,40,640	4,40,725	6,59,366
,, ,, Sind ...	...	209	...	...	...	...	...	584	...	...	...	...
,, ,, Madras	8	...	27	450	6,965	12,490	249	...	91	1,630	19,213	53,432
TOTAL Yds. ...	113,228	78,733	145,592	137,960	126,784	134,452	3,44,782	2,25,413	4,62,659	4,67,861	4,77,668	7,26,565
lbs. ...	138,022	97,212	172,162	163,560	149,476	172,408						

NOTE : *Itemt of Japan are included " Other Foreign Countries."

STATEMENT XI
Imports of Shawls and Lohis

	QUANTITY (Nos.)						VALUES (IN Rs.)					
	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41
United Kingdom (including Channel Islands) ...	1,761	2,880	16,867	1,433	584	207	5,882	8,551	90,323	4,883	1,274	580
Burma ...	...	...	4,300	...	358	10	...	...	5,950	...	1,164	55
Other British Possessions ...	675	219	21	50	...	109	2,342	660	72	213	...	420
TOTAL BRITISH EMPIRE ...	3,436	3,099	19,888	1,483	942	326	8,224	9,211	96,345	5,096	2,438	1,055
Germany ...	153,055	238,357	286,347	104,930	5,738	...	5,75,719	7,82,433	11,64,868	3,90,739	22,912	...
France ...	45,535	11,899	12	16,557	304	...	89,541	12,004	18	48,735	987	...
Italy (including Fiume) ...	50,140	...	10,000	3,500	1,000	1,123	80,030	...	36,942	9,579	2,418	1,057
Japan ...	248,092	239,903	176,427	352,316	141,438	74,011	3,92,588	4,81,921	5,30,736	9,32,429	3,46,545	3,25,395
Other Foreign Countries ...	1	1,502	341	2	36	1	12	4,267	1,779	5	140	10
TOTALFOREIGN COUNTRIES...	496,823	491,661	472,927	477,305	148,516	74,135	11,37,890	12,80,625	17,34,343	13,81,487	3,73,002	3,26,462

STATEMENT XI—(*contd.*)

	QUANTITY (Nos.)						VALUES (IN Rs.)					
	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41
Share of Bengal...	107,925	133,405	69,236	27,274	14,183	2,950	2,96,663	3,60,066	2,38,454	1,02,458	31,311	2,296
,, ,, Bombay	80,667	75,691	106,884	67,837	8,374	5,331	3,07,687	2,53,966	4,30,245	1,96,062	27,555	18,078
,, ,, Sind ...	93,851	148,787	261,345	364,468	126,247	66,095	2,79,292	4,87,993	10,10,000	10,36,756	3,14,986	3,06,957
,, ,, Madras	34,503	34,309	55,350	19,279	654	85	99,346	84,493	1,51,989	52,307	1,588	186
,, ,, Burma...	183,313	102,573	...	...	...	...	1,63,126	1,03,318	...	...	...	...
TOTAL ...	500,259	494,760	492,815	478,788	149,458	74,464	11,46,114	12,89,836	18,30,688	13,86,583	3,75,440	3,27,517

STATEMENT XII

Import of Other Sorts Manufactures

	QUANTITY (IN lbs.)						VALUES (IN Rs.)					
	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41
United Kingdom (including Channel Islands) ...	162,923	191,554	373,626	180,131	125,988	110,396	1,28,937	1,48,419	3,10,096	1,15,326	2,06,150	2,97,500
Commonwealth of Australia ...	...	...	...	5	11	32,787	...	...	...	30	14	62,979
Other British Possessions ...	355	2	2,564	868	2,829	1,112	373	5	2,346	670	2,601	643
TOTAL BRITISH EMPIRE ...	163,278	191,556	376,190	181,004	128,828	144,295	1,29,310	1,48,424	3,12,442	1,16,026	2,08,765	3,61,122
Poland (including Danzing) ...	530,161	522,957	222,648	282,505	49,346	15,089	3,97,183	3,82,017	2,57,250	2,44,991	62,599	13,319
Germany ...	139,614	60,468	63,143	46,771	8,936	...	1,25,779	75,092	86,221	66,378	16,115	...
Belgium ...	...	798	136	3,727	...	...	...	851	171	7,393	...	...
Italy (including Fiume) ...	796,429	431,807	1,007,685	832,103	176,916	2	7,49,755	4,00,129	10,27,452	8,02,324	1,96,068	2
Hungry ...	6,123	3,754	2,376	10,241	12,211	...	9,174	4,451	4,381	11,252	44.082	...
Japan ...	3,267	3,328	14,961	3,374	735	5	5,594	1,310	38,537	9,702	831	7

STATEMENT XII —(*contd.*)

	QUANTITY (IN lbs.)						VALUE (IN Rs.)					
	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41
United States of America Via Atlantic Coast ...	559	2	3,510	3,603	358	39	492	34	2,123	9,622	1,101	187
,, Pacific Coast	1	...	...	...	...	...	3	...	...	...	...	...
Other Foreign Countries ...	273	3,437	3,450	1,410	3,177	212	732	2,219	6.853	2,223	3,668	138
TOTAL FOREIGN CUONTRIES...	1,476,427	1,026,551	1,317,909	1,183,793	251,679	15,947	12,88,712	8,66,103	11,40,988	11,53,85	2,87,464	13,653
Share of Bengal...	447,663	444,145	441,584	346,957	70,232	80,854	3,93,857	3, 74,333	5,04,713	3,51,529	91,872	1,62,424
,, ,, Bombay	769,084	492,380	667,761	672,302	241,991	66,865	6,98,375	4,19,782	7,32,859	6,64,163	3,12,739	1,82,868
,, ,, Sind ...	375,718	215,821	579,535	342,926	65,667	7,958	3,00,761	1,92,055	5,05,989	2,49,178	89,816	22,641
,, ,, Madras	3,087	4,063	5,219	2,912	2,617	4,565	5,357	7,327	9,869	5,041	1,802	7,342
,, ,, Burma...	44,153	61,698	...	...	...	...	19,672	21,030	...	...	...	...
TOTAL ...	1,639,705	1,218,107	1,694,099	1,364,797	380,507	160,242	14,18,022	10 14,527	17,53,420	12,69,911	4,96,229	3,74,775

STATEMENT XIII

Exports of Woollen Piece Goods

	QUANTITY (IN Yds.)						VALUE (IN Rs.)					
	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41
United Kingdom (including Channel Islands) ...	1,162	5,751	20,808	12,283	2,582	61	5,170	10,466	23,602	7,496	5,102	413
Palestine ...	1,450	400	...	...	...	26,192	7,800	900	...	...	...	60,202
Aden and Dependencies ...	11,753	26,327	38,061	23,667	3,594	424	20,600	41,835	54,476	33,370	6,360	1,388
Bahrein Islands...	1,461	12,361	14,948	20,858	31,634	10,891	4,315	19,319	27,615	35,784	38,875	22,791
Ceylon (excluding Maldives) ...	1,856	12,559	28,492	11,426	1,479	23,603	2,716	7,155	22,255	5,895	2,425	11,530
Burma ...	...	...	42,891	18,781	31,498	83,426	...	...	57,512	31,319	48,002	1,14,327
Zenzibar and Pemba ...	2,117	2,811	2,213	384	...	...	3,910	5,850	3,525	800	...	...
Kenya Colony ...	5,407	13,699	2,743	7,140	833	11,493	13,050	30,940	6,690	14,435	725	3,344

STATEMENT XIII—(*contd.*)

	QUANTITY (IN Yds.)						VALUE (IN Rs.)					
	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41
Tanganyika Territory ...	354	3,143	7,533	1,854	664	344	600	5,675	11,970	3,150	1,100	776
Anglo-Egyptian Sudan ...	506	2,952	5,400	4,004	1,455	52	925	4,258	8,725	6,185	2,100	182
Other British Possession ...	545	1,049	1,987	1,207	644	339	1,040	1,300	4,858	2,089	887	1,188
TOTAL BRITISH EMPIRE ...	26,611	81,052	165,076	101,604	74,683	146,855	60,126	1,27,698	2,21,228	1,40,523	1,05,576	2,16,141
Belgium ...	6,639	...	...	...	...	...	17,600	...	...	...	...	...
Maskat Territory and Truical Oman ...	...	5,834	5,733	6,413	11,763	3,015	...	10,437	12,112	11,172	16,531	6,709
Other Native States in Arabia	4,791	15,961	13,977	28,064	37,419	42,286	9,486	30,930	23,360	47,242	42,278	49,269
Iraq ...	750	...	5,149	12,856	66	24,932	1,660	...	3,500	14,300	186	60,325
Iran ...	20,999	8,942	...	940	475	9,234	41,983	19,974	...	2,200	1,726	26,435
Japan ...	6,409	961	549	27,342	18,222	...	16,117	3,156	2,315	61,305	29,527	...

Chnia (exclusive of Hongkong and Macao) ...	112	184	80	75,310	17,768	16,943	280	1,191	280	8,934	31,391	28,147
Egypt ...	...	...	...	...	1,127	9,782	..	...	...	...	1,367	19,000
Other Foreign Countries ...	644	2,818	3,430	458	1,342	771	895	5,465	6,132	2,000	4,683	1,575
TOTALFOREIGN COUNTRIES...	40,344	34,700	28,918	81,383	88,182	106,963	87,961	71,153	47,699	1,47,153	1,27,698	1,91,460
Share of Bengal...	1,494	35	31,066	7,093	18,481	51,840	5.517	260	30,466	12,239	17,620	37,935
„ „ Bombay	54,987	106,033	161,807	170,869	141,142	201,737	1,05,262	1,80,285	2,36,354	2,63,834	2,08,924	3,78,678
„ „ Sind ...	10,474	8,110	834	5,025	3,242	241	37,308	16,270	1,442	11,603	6,721	988
„ „ Madras	...	1,205	287	...	...	...	...	1,205	665	...	...	...
„ „ Burma...	...	369	...	...	...	...	...	831	...	...	...	...
TOTAL ..	66,955	115,752	193,994	182,987	162,865	253,818	1,48,087	1,98,851	2,68,927	2,87,676	2,33,265	4,07,601

STATEMENT XIV

Re-export of Woollen Shawls

	QUANTITY (Nos.)						VALE (IN Rs.)					
	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41
Burma ...	1,020	373	932	2,637	539	150	...	...	4,420	9,000	3,100	1,084
Kenya Colony ...	1,020	373	1,604	3,941	1,360	...	1,765	1,605	2,770	7,105	1,825	...
Other British Possessions ...	150	905	2,307	792	750	...	400	2,733	6,982	5,466	1,746	...
TOTAL BRITISH EMPIRE ...	1,170	1,651	4,813	7,370	2,649	150	2,165	4,338	14,172	21,571	6,671	1,084
Japan ...	...	...	...	5,100	...	...	...	...	...	22,900	...	...
Other Foreign Countries ...	30	250	2,556	5,603	200	95	150	1,200	5,713	1,900	700	41
TOTALFOREIGN COUNTRIES...	30	250	2,556	5,708	200	95	150	1,200	5,713	24,800	700	41
Share of Bengal...	1,200	...	2 396	...	307	150	...	...	5,188	...	1,500	1,084
" " Bombay	1,200	1,233	3,611	4,936	1.560	95	2,315	3,635	8,520	13,185	2,525	4
" " Sind ...	...	...	200	5,200	550	...	...	...	825	23,350	1,227	...
" " Madras	...	295	1,192	2,837	432	...	...	993	5,352	9,836	2,119	...
TOTAL ...	2,400	1,528	7,399	12 973	2,849	245	2,315	4,628	19,885	46,371	7,371	1,088

STATEMENT XV

Re-exports of Other Sorts Manufacture

	QUANTITY (IN lbs.)						VALUE (IN Rs.)					
	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41
United Kingdom (including Channel Islands ...	252,058	741,049	267,669	356,645	419,282	123,593	3,56,964	10,31,379	4,24,147	5,18,705	7.58,434	2,17,645
Palestine ...	3,220	2,880	728	2,044	336	376	8,200	11,200	2,100	4,000	1,500	1,200
Aden and Dependencies ...	3,478	25,870	7,416	13,739	1,660	7,626	7,870	35,105	10,305	21,090	1,207	13,714
Bahrein Islands...	5,019	21,600	31,076	19,633	18,004	2,222	6,415	22,965	36,350	26,173	18,033	3,749
Ceylon (including Maldives) ...	1,130	3,861	6,996	9,894	8,179	5,552	2,933	8,628	5,700	9.000	5,573	6,834
Burma ...	...	...	18,952	17,311	42,325	59,471	...	...	42,544	29,402	51,190	1,08,806
Straits Settlements	8,122	3,115	6,934	10,193	4,983	4,702	19,762	7,992	27,093	42,158	29,409	19,125
Hongkong ...	1	...	15.591	620	172	...	5	...	13,?11	2,923	900	...
Zanzibar and Pemba ...	1,376	2,399	1,330	1,914	168	...	3,50)	8,907	2,850	4,000	300	...
Kenya Colony ...	2,648	3,070	2,853	3,970	3,221	2,349	5,222	5.699	3.720	6,390	4,959	6,921
Tanganyika Territory ...	50	3,006	1,749	2,838	372	504	65	4,405	2,470	5,570	593	1,200
Commonwealth of Aurtralia ...	996	142	240	7,402	[8,778	...	3,043	675	352	10,321	11,179	...

STATEMENT XV—(*contd.*)

	QUANTITY (IN lbs.)						VALUE (IN Rs.)					
	935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1935-36	1936-37	1937-38	1938-39	1939-40	1040-41
Other British Possession ...	432	1,414	6,250	4,837	8,234	1,328	1,298	2,700	6,424	4,186	8,464	2,223
TOTAL BRITISH EMPIRE ...	278,530	808,406	367,784	451,010	515,714	208,323	4,15,277	11,39,655	5·77,266	6,84,831	8,91,840	3,81,417
Germany ...	22,014	6,565	52,940	49,966	24,540	...	10.702	12,028	83,726	18,340	42,100	...
Netherlands ...	2.268	...	15,432	13,272	12,045	1,019	5,799	...	24,138	20,433	23,172	2,000
Belgium ...	734	...	157	14,483	...	...	1,450	...	300	14,705	...	...
France ...	99	1,1·0	6,158	1,045	1,137	...	395	1,130	15,000	2,583	1,776	...
Switzerland ...	...	308	1,064	4,743	199	...	...	960	2,655	5,110	300	...
Italy (including Fium) ...	2,347	4,790	956	1,095	388	...	7,036	7,705	3,610	4,445	1,000	...
Turkey. European	49,221	13,104	13,192	18,968	17,610	1,344	66,200	19,600	27,350	25,300	25,300	5,000
Maskat Territory and Trucial Oman ...	4,272	6,349	11,615	9,174	7,901	6,790	5,288	6,740	11,413	11,120	7,642	7,893
Other native States in Arabia	5,869	14,271	11,991	10,852	19,923	547	6,331	18,066	11,465	16,160	16,813	755
Iraq ...	1,606	310	1,143	2,144	6,276	9,759	4,500	805	4,200	3,110	6,458	19,465
Java ...	785	...	2,576	6,144	2,699	8,430	2,438	...	6,100	12,583	4,680	31,971

Philippines ...	224	1,736	168	1,085	2,350	112	1,000	4,467	350	2,160	12,031	1,429
Japan ...	3,384	411	2,351	7,766	336	150	7,019	762	6,903	22,150	1,533	550
Egypt ...	13,646	2,192	740	7,840	1,515	22,331	28,700	5,550	4,010	15,601	4,985	63,100
United States of America Via. Atlantic Coast ...	4,402	6,692	18,338	2,359	868	85,666	2.761	39,380	1,18,979	5,919	2,248	2,32,855
,, Pacific Coast ...	224	...	65	150	...	...	1,300	...	260	310	...	...
Other Foreign Countries ...	5,304	3,792	3,073	4,643	4,508	1,212	6.525	5,120	7,475	9,447	5:334	1,286
TOTAL FOREIGN COUNTRIES..	116,402	61,650	141,959	155,735	102,334	137,361	1,57,444	1,22,313	3,27,934	2,19,761	1,55,372	3,66,304
Share of Bengal...	19,545	3,530	34,221	13,652	34,736	40,001	7,456	9,739	44,474	19,611	42,416	71,891
,, ,, Bombay	98,163	255,628	169,319	171,446	212,468	213,855	1,71,968	4,15,148	2,92,665	3,19.971	4,22,262	5,06,501
,, ,, Sind ...	276,470	609,370	306,203	421,677	370,800	61,828	3,91,288	8,35,459	5,78,061	5,65,010	5,82,434	1,69,329
,, ,, Madras	100	1,130	...	...	44	...	575	1,130	...	...	100	...
,, ,, Burma...	654	65	...	...	...	...	1,484	512	...	...	...	...
TOTAL ...	394,932	870,056	509,743	606,775	618,048	345,684	5,72,721	12,61,968	9,05,200	9,04,592	10.47,212	7,47,721

REPORT

OF THE

PANEL ON HOSIERY INDUSTRY.

Government of India
Department of Industries & Supplies

Price -/5/- or 6d.

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NEW

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INTRODUCTION.

The Government of India in the Department of Planning & Development constituted a Panel to consider and make recommendations to them regarding the post-war development of the Hosiery Industry in India. The Panel consisted of the following members:—

Chairman

Sir Har Govind Misra, Kt., O.B.E.

Members

Mr. A.W. Tatlow.
Mr. W. Firth.
Mr. Fakhruddin.
Mr. A.K. Choudhuri.
Mr. H.R. Dhanda.

Secretary

Mr. A.S. Bhatnagar,
Asstt. Industrial Adviser.

Mr. M.H. Mahmood acted as the Secretary of the Panel upto the 12th October 1945.

II. The following general directive was issued by the Government of India to indicate the scope of the Panel and the procedure to be adopted by it.

GENERAL DIRECTIVE.

It is the function of panels to make recommendations to Government regarding the development of industries, both existing and new. These recommendations should be so framed as to enable Government to prepare a detailed phased plan for the five years following the cessation of hostilities, as the first stage of a 15-year plan of industrial development for the whole country.

2. In order to assist them to formulate recommendations panels will be supplied, as far as possible, with factual information prepared by the panel secretaries. In the case of new industries, the information will consist of a general survey of the industry and the importance of starting it in India, the availability of raw material, the power requirements, the demands of the Indian markets and the probabilities of exports. In the case of existing industries, the information will naturally be more comprehensive ; it will indicate in addition, the location of existing units, the types of goods produced, the total production under each category and the assistance, if any, given by Government. These items are to be regarded as illustrative and not exhaustive.

Government will give each panel, as a basis, for discussion, the provisional target to be aimed at in the first five-year period and wherever possible, of the target to be reached in 15 years.

3. The recommendations of the panels should cover the following points:—

(1) The scope and extent of development, including the type of products recommended.

(1-A) The estimated requirements of capital goods together with such details of those requirements as may be available in India and how much should be imported from abroad.

(2) Whether the industry should be under Government ownership either on grounds of national interest or because private capital is unlikely to take it up, and if so, whether it should be wholly or partly managed by Govern nt.

(3) In the case of industries to be developed other than under State ownership, the capital required for such development, whether the whole of it is likely to be available by public investment and, if not, the extent to which Government assistance may be required.

(4) The extent to which technical advice from abroad may be necessary.

(4-A) The availability and the future requirements of technical personnel so as to obtain a clearer indication of the present shortcomings and future needs.

(5) The manner and the degree of co-operation with foreign firms considered necessary and desirable, both as regards capital and management.

(6) The location of the industry.

(7) The nature of the assistance required from Government in the form of protective duties, bounties, research grant, expert advice, etc.

(7-A) The relative incidence of the import duty on the finished goods in comparison with the duty on the raw materials from which they can be manufactured.

(8) If the industry is to be under private ownership and management, what controls. if any, should be exercised by Government.

(9) What should be the organisation of the different units of the industry, e.g., should there be an industrial association ? Would a cartel be desirable ?

(10) The stages by which the industry should be developed.

(11) Should the industry cater for the export market ?

(12) Should the industry be developed as in Japan, on the cottage industry basis and, if so, to what extent ?

4. Although, as stated above, the panels may recommend the grant of protection, it will not be their function to consider broad questions of international trade and commercial policy.

5. Joint meetings of the panels should be held, wherever necessary, to secure co-ordination particularly where the processes and the products of one industry are connected with those of another.

6. Some of the panels have been drawn broadly and it may be necessary to co-opt members for dealing with specific branches of the industry. Members may be co-opted by the Chairman in consultation with the Industrial Adviser.

7. Before submitting recommendations, panels should consult Provincial Industrial Committees, particularly in the matter of location of industry. They should also, where the circumstances of the case require it, consult Industrial Committees in States or State Governments/Durbars. The recommendations should be submitted to Government through the Industrial Adviser.

III. A preliminary note on the Indian Hosiery Industry prepared by the Secretary was circulated amongst the Panel members before the first meeting.

IV. The meetings of the Panel were held on the following dates :—

(*a*) First meeting held on the 19th October 1945 at New Delhi.

(*b*) Second meeting held on the 7th January 1946 at New Delhi.

(*c*) Third meeting held on the 26th February 1946 at New Delhi.

(*d*) Fourth meeting held on the 18th April 1946 at New Delhi.

(*e*) Joint meeting of the Panel with the representatives of Provincial and State Governments and their Industries Committees held on the 3rd June 1946 at New Delhi.

V. The Panel is grateful to the Chairman for his constant interest in the work of the Panel.

VI. In the end the Panel wishes to place on record its appreciation of the valuable services rendered by the Secretary, Mr. A.S. Bhatnagar whom the Panel considers to be a capable officer with unlimited zeal and enthusiasm for his work.

HOSIERY INDUSTRY.

Growth of the Industry.

The hosiery industry has now been in existence in India for the last fifty years or so. Main centres of hosiery manufacture are in Bengal, the Punjab, the United Provinces, Bombay, Madras and some Indian states.

2. The growth of this industry in Bengal can be traced back to the early days of the Swadeshi movement, when some Bengali patriots made a crude venture of manufacturing socks by hand driven knitters. These products received an enthusiastic market and the venture slowly and steadily grew up into a medium sized industry. Various improvements notably in the use of power driven machines were effected and better quality goods were produced. It is estimated that in 1930 there were about 30 small factories with an average of 5 knitters each working in areas round about Calcutta. The total number of labourers employed in these factories was about 200. The main items of manufacture were plain knitted cotton vests from imported yarn.

3. The most important hosiery centres in the Punjab are Ludhiana, Lahore and Rawalpindi. The origin of the industry at Ludhiana dates back to the time when after a devastating famine in Kashmir, certain families in distress left their homes and settled in different parts of the Punjab. A number of these emigrants reached Ludhiana and with their traditional skill and artistic sense soon transformed the town into a growing centre of industry. Their women folk knew several arts including that of knitting socks on wooden or steel rods, and they laid the foundations of a craft which form a useful pastime for ladies has now developed into an important industry. It was in 1890, that this primitive organisation of hosiery knitting by the womenfolk was given up and machine knitting was introduced.

4. The next step forward was taken during the first World War when like many other indigenous industries, the hosiery industry also received its share of the war boom, which however did not prove to be an unmixed blessing. The industry was compelled to confine itself to the production of coarse khaki stockings for the military. It possessed neither adequate capital nor a sufficiently elastic organisation to adapt itself to meet the requirements of the military and to retain at the same time its normal markets in the country. The result was that while the production of stockings for the military was in full swing, the civil hosiery market was invaded by low priced knitted goods from Hong Kong and Japan. This proved to be a very disturbing factor and led to many serious difficulties in the development of the indigenous industry. The crisis after the last World War was responsible for the introduction of two important changes in the industry. Firstly the manufacturers who had till then confined their attention to foot-wear alone began to produce woollen sweaters and pullovers; and soon Ludhiana developed a brisk trade in this quality of goods. Secondly the Ludhiana manufacturers realised the shortcomings of hand worked knitters and installed power driven machinery. Whereas in 1927 there were only 2 power driven knitters out of 900 hosiery machines, in 1932, sixteen hosiery manufacturers of Ludhiana had mechanised their establishments. In 1941 the number of power driven factories in the district exceeded one hundred.

5. The hosiery industry is also firmly established in the United Provinces, Bombay and Madras. The hosiery factories in the United Provinces (mostly in Cawnpore) and Bombay are fewer in number but larger in size

while in Madras and Bengal the smaller factories are more numerous. The industry is also growing in some Indian States, such as Mysore, Indore Gwalior, Kapurthala etc.

6. During the depression following the 1st World War the industry passed through a period of hardship. Besides the effects of foreign competition the industry suffered in common with other industries by an alarming fall in the prices of manufactured goods. The prices fell by twentyfive to thirty-three percent as against a reducation of only fifteen percent in the price of yarns. The fall in the prices of finished hosiery goods was met by reducing the profits and increasing the efficiency. The depreciation of the Japanese yen also adversely affected the hosiery industry. This along with other advantages possesed by Japan in the supply of raw materials, efficient labour and up-to-date machinery gave Japanese hosiery a dominating position in the Indian markets. The revenue duty of thirty percent which had been levied on Japanese imports before 1934 was not found to be high enough to afford adequate protection to the Indian hosiery industry. Apart from these handicaps the Indian hosiery manufacturers suffered from several internal difficulties, which put extra burdens on them and worsened their position. Consequently the Indian hosiery manufacturers approached the Central Government for the grant of adequate protection against foreign competition. The demand was largely conceded in the Tariff Amendment Act of 1934 which for the first time afforded adequate protection to the hosiery industry against Japanese dumping. The Tariff Act was amended in 1936 to cover all branches of the hosiery industry. The tariff schedule for hosiery goods is given in Statement X attached to this report.

7. The present War, on account of the stoppage of imports chiefly from Japan, brightened the prospects of the industry ; but the shortage of yarns and the scarcity of hosiery machine needles for which the industry was dependent upon foreign supplies, did not allow the manufacturers to take full advantage of the position. In the case of manufacturers with whom the Supply Department had placed orders for the Defence Forces the difficulties were removed by that Department by supplying yarns and needles; but generally speaking the condition of the hosiery industry during this War has been any thing but satisfactory. The lesson to be learnt from the difficulties experienced during this War is that in order to ensure the future of the industry India must be made self-sufficient in regard to her requirements of hosiery machine needles and yarns.

Present organisation of the industry :—

8. The hosiery industry is carried on in India in varying units. Some of the large textile mills have separate hosiery sections and produce knitted goods on power driven machines. There are also some fairly large sized hosiery factories employing power driven knitters. The industry is also being run on cottage industry basis in several parts of the country and a very large number of cottage workers are engaged in it. The factories work regularly while the work of the cottage workers is mostly seasonal.

9. The hosiery industry can be classified as cotton, woollen, silk and artificial silk, according to the type of yarn used in the manufacture of knitted goods.

Cotton hosiery :—

10. Cotton hosiery goods are manufactured in Bengal, the United Provinces, the Punjab, Bombay, Madras and several Indian States. This branch of the industry accounts for over eighty-five percent of the total consumption of yarn by the hosiery industry in India and is easily the most important. The Madura Mills in Madras Province are the most important producers of cotton hosiery yarn, and very little foreign yarn and that of only very high counts, is used. The main items of manufacture are socks, stockings, underewear, outerwear etc. In addition to local production, large quantities of cotton hosiery goods are imported. Statements I to IV give the import figures of cotton hosiery goods in the country during various pre-war years. The total value of goods imported in 1937-38 was Rs. 29 lakhs and in 1940-41 was Rs. 17.8 lakhs Japan was the chief exporter of hosiery goods to India and in 1937-38 exported cotton hosiery goods worth Rs. 25 lakhs.

Woollen hosiery :—

11. The Woollen hosiery industry is of more recent origin. The largest output of woollen hosiery comes from the Punjab where the growth of this branch of the industy was greatly facilitated by the import of cheap marino yarn from Japan. The industry has also fairly well established itself in Cawnpore, Bombay and Calcutta. The Indian woollen hosiery industry is uptil now dependent upon imported foreign yarn which factor has been greatly responsible for its restricted growth during the present War. According to figures given in the Sea-Borne Trade of India the average annual imports of woollen yarn for hosiery and knitting for the quinquennium 1935-36 to 1939-40 amounted to Rs. 23 lakhs out of which the average share of Japan was about Rs. 15 lakhs. The value of imports of woollen hosiery goods in India in 1937-38 was Rs. 13.97 lakhs and in 1940-41 was Rs. 5.8 lakhs (Statements VI & VII).

Silk hosiery :—

12. The silk hosiery industry also depended for its supply of yarn from Japan. It is estimated that about ninety-five percent of the silk yarn consumed in India by the silk hosiery industry was imported from Japan. Some silk yarn is produced in Kashmir, Mysore and Bengal, but the quality has so far not been suitable for the manufacture of hosiery goods. The production of silk yarn suitable for hosiery industry is therefore the first step necessary for the maintenance and expansion of the silk hosiery industry. The main items of manufacture are socks and stockings. In addition to indigenous production silk socks and stockings worth Rs. 1.24 lakhs were imported in the year 1937-38 (Statement VIII).

Artificial silk hosiery :—

13 The advent of artificial silk brought a transformation in the activities of the hosiery manufacturers throughout the world. The Indian industry also partly switched on to the manufacture of artificial silk goods. Like the silk hosiery industry, this branch of the industry is also dependent upon imported yarn. No artificial silk yarn is manufactured in India at present but it is hoped that this industry will be started in the post-war period, when it will be able to meet the requirements of the artificial silk hosiery industry. Total imports of artificial silk hosiery goods in 1937-38 amounted to Rs. 8.12 lakhs out of which Japan claimed a share of no less than Rs. 6.59 lakhs (Statement IX).

Post-war production target :—

14. Hosiery is often defined as a common man's garment. With the rise in the standard of living and increase in the purchasing power of the people, the demand of hosiery goods is bound to increase rapidly in the post-war period. The Panel strongly feels that the present production of hosiery goods in the country falls far short of the consumption. With improvement, of quality, better standardisation of products and cheaper costs of production hosiery wear will gain great popularity amongst the masses.

15. The Panel recommends the following annual production target for hosiery goods in India during the next five year period.

ANTICIPATED PRODUCTION IN 1951.

Type of garment	Annual production target in 1951	Quantity of yarn required
1. Underwear.	600 million pieces (including 200 million pieces for export)	150 million lbs. @ about 4 ozs. per garment.
2. Outerwear including neck-wear head-wear etc.	100 million pieces (including 33 million pieces for export)	37½ million lbs. @ about 6 ozs. per garment.
3. Foot-wear including socks, stockings etc.	50 million pairs (including 17 million pairs for export)	4 million lbs. @ about 1 lb. per dozen pairs.

The broad basis of calculation adopted is that on an average the consumption of under-wear in the post-war period will be one piece per capita. The Panel feels that Indian industry will be able to meet the entire requirements of the country and no imports of hosiery goods will be necessary in the post-war period.

16. The Panel is of the opinion that the percentage of cotton, woollen and artificial silk or rayon hosiery goods in the proposed expansion of production may be estimated as follows :—

ANTICIPATED PERCENTAGE OF COTTON WOOLLEN AND RAYON HOSIERY.

Type of garment.	Anticipated % of cotton hosiery.	Anticipated % of woollen hosiery.	Anticipated % of rayon & staple fibre hosiery (including silk).
1. Under-wear	80	10	10
2. Outer-wear	60	40	—
3. Foot-wear	70	20	10

Hosiery yarn :—

17. The main raw material required by the industry is the hosiery yarn. In the pre-war period yarn used for woollen, silk and artificial silk hosiery was all imported mainly from Japan. Cotton yarn was manufactured in the country except the very finer counts, which was imported. During the war there

was an acutes carcity of hosiery yarn in the country and consequently the hosiery industry suffered a lot. It is also feared that in the post-war period, the Indian hosiery industry may not be able to get its requirements of cotton hosiery yarn from the textile mills for the following reasons :—

(i) tendency of the Indian textile mills to consume their yarn production in their own weaving sections.

(ii) present policy of the Provincial Governments to divert yarn to hand loom weavers.

The Panel is, threfore, strongly of the opinion that the Government should keep in view the requirements of the hosiery industry when allocating spinning plants, for cotton, woollen and worsted yarn. The production of woollen and worsted yarn suitable for the hosiery industry should be encouraged and developed in the country. It is also felt that in order to develop the use of artificial silk hosiery goods, early steps should be taken to establish the artificial silk or rayon yarn industry in India.

Hosiery machinery (Knitting machines) :—

18. In the beginning hosiery machines were imported from the United States of America, United Kingdom and the Continent, but later Japan entered the field and Japanese hosiery machines, which were comparatively cheaper, gained popularity. Due to the stoppage of imports during this War and over-strain on the existing machines, on account of military contracts, most of the hosiery machines installed in the country have worn out and require immediate replacement. The Panel strongly recommends that Government should allow a free import of knitting machines sewing, dyeing and finishing equipment, mercerisation plants, sewing thread, hosiery needles, fabricating machinery, high speed winding machines for winding hosiery yarn, sinkers and other small accessories required by the industry. It is understood that the imports of hosiery needles and hosiery goods have been included in the open general license list. The Panel strongly recommends that the import of knitting machines should also be included in this list.

19. It is estimated that for the proposed post-war expansion of hosiery goods production in India, the number of knitting machines required will be as follows :—

Type of garment.	No. of knitting machines required to reach anticipated production.	No. of machines to be imported.
1. Under-wear	10,000	9,500
2. Outer-wear	5,000	4,500
3. Foot-wear	1,500 including auxiliary machines such as rib tops, looper machines etc.	1,500

20. The Panel is of the opinion that modern types of knitting machines perfected in foreign countries producing specialised knitted goods should be introduced in this country. With this in view, the Panel recommends that Government should provide facilities to prospective purchasers of hosiery machinery to visit United Kingdom, the United States of America and other foreign countries who may be allowed to export machinery, for the purchase of most up-to-date plants.

Hosiery needles :—

The hosiery needle is the most vital component of hosiery machinery and it is a surprising fact that India does not possess even a single needle manufacturing plant. During the war, there was an acute scarcity of hosiery needles in the country. A needle which was selling at 6 pies per piece in the per-war days fetched Rs. 3/- during this period. It is essential that in the post-war period, the Indian hosiery industry should not remain dependent upon foreign supplies of this most vital component. The Panel, therefore, strongly recommends that early steps should be taken to establish needle manufacturing plants in the country. Industrialists desirous of putting up such plants should be given all encouragement and facilities by the Government. The Panel also feels that possibilities of manufacfuring knitting machines in the country should be explored.

Capital goods :—

22. It is estimated that for the proposed expansion in production the hosiery industry will require capital goods worth about Rs. 10 crores during the next five year period.

Reparations from enemy countries :—

23. The Panel feels that if, as it is believed likely to be the case, any share of the plants existing in enemy countries should fall to India's share, the requirements of the hosiery industry should be kept in view. Although we are fully aware that adaptations have been made to Japanese machinery whereby they have been kept in production, it is felt that good use can be made in this country of Japanese heavy production machinery for the manufacture of hosiery needles and knitting machines. It is interesting to note that the wire needles which are used in English and American knitting machines do not fit the Japanese knitters. It is a known fact that a majority of knitters installed in India today are of Japanese make which use plate needles of various types. The fact that Japan will not be able to export these needles for the coming few years, further fortifies India's urgent demand for Japanese heavy machinery for the hosiery industry. The Panel strongly suggests that the Government should insist for at least one Japanese plant for the manufacture of hosiery needles. In this connection the Panel also recommends that one or two hosiery manufacturers preferably with technical knowledge should be included in the Government technical missions which are being sent to enemy countries.

Location of Industry:—

24. The Panel is of the opinion that apart from the general principles laid down in the Government's statement on industrial policy, no other factors should govern the future location of hosiery factories in India.

Prospects of export trade:—

25. The Panel is strongly of the opinion that there are extremely bright prospects for the export of the Indian hosiery products in the post-war periord. Full advantage should be taken of the elimination of Japan from the export trade field for at least the coming few years. The Panel feels that Government should provide all facilities such as reduction of railway freights, shipping facilites etc., for creating a profitable export trade in hosiery goods with Middle East, Far East and other adjoining countries.

Future structure of the industry :—

26. The Panel feels that the hosiery industry should be entirely owned by private enterprise. The Panel is of the opinion that the necessary capital required for the projected expansion of the hosiery industry would be forthcoming. It is estimated that during the first five years of the post-war development plan a sum of nearly Rs. 20 crores will be required by this industry.

Foreign co-operation :—

27. The Panel feels that the hosiery industry does not require any foreign co-operation both as regards capital and management.

Protection :—

28. The Panel is of the opinion that the present rate of tariff granted to the industry should be continued.

Government controls : —

29. The Panel feels that there should be no Government controls for the development of this industry except those which may form part of the general industrial policy of the Government.

Research Grant : —

30. The Penel recommends that a separate research section should be attached to the Cotton Technological Laboratory, Indian Central Cotton Committee, Bombay, for tackling research problems of the Indian hosiery industry. An adequate grant should be sanctioned for this purpose. The Government should also give annual grants to the existing hosiery institutes at Ludhiana (Punjab), Cawnpore (U.P.) and Serampur (Bengal), where facilities for traning of technical personnel for this industry already exist.

Development on cottage industry basis :—

31. The Panel considers that the existing cottage industry system may be suitably adjusted with the aid of co-operative organisations and with the introduction of improved appliances and machinery for the development of this industry in the near future. When Government electrification plans mature and cheap electric power is available in the rural and urban areas and where cheap hydal power is already obtainable, this industry can in fact thrive on a cottage industry basis.

Industrial Association :—

32. The Panel strongly recommends that hosiery manufacturers should form themselves into an association for the development of this industry particularly with regard to fixing specifications and grades of products for internal and export markets. The Panel does not favour a cartel for this industry.

SUMMARY OF RECOMMENDATIONS.

1. The Panel recommends the following production target for hosiery goods during the next five-year period.

Type of garment.	Annual production target in 1951	Quantity of yarn required.
1. Underwear	600 million pieces (including 200 million pieces for export)	150 million lbs. @ about 4 ozs. per garment.
2. Outerwear including neck-wear, head-wear etc.	100 million pieces (including 33 million pieces for export)	37½ million lbs. @ about 6 ozs. per garment.
3. Foot-wear including socks, stockings etc.	50 million pairs (including 17 million pairs for export).	4 million lbs. @ about 1 lb. per dozen pairs.

2. Regarding the question of supply of yarn for the hosiery industry, the Panel recommends that the Government should keep in view the requirements of the hosiery industry when allocating spinning plants, for cotton woollen and worsted yarn.

3. The Panel recommends that the Government should allow a free import of knitting machines, sewing dyeing and finishing equipment, mercerisation plants, sewing thread, hosiery needles, fabrication machinery, high speed winding machines for winding hosiery yarn, sinkers and other small accessories required by the industry.

4. The Panel recommends that early steps should be taken to establish factories for the manufacture of hosiery needles and knitting machines in India.

5. The Panel feels that if, as it is believed likely to be the case, any share of the plants existing in enemy countries should fall to India's share, the requirements of the hosiery industry should be kept in view.

6. Regarding location of industry, the Panel is of the opinion that apart from the general principles laid down in the Government's statement on industrial policy, no other factors should govern the future location of hosiery factories in India.

7. The Panel feels that there are extremely bright prospects for the export of Indian hosiery goods.

8. The Panel recommends that the hosiery industry should be entirely owned by private enterprise.

9. The Panel recommends that the present rate of tariff granted to the industry should be continued.

10. The Panel recommends that there should be no Government controls for the development of this industry except those which may form part of the general industrial policy of the Government.

11. The Pannel recommends that a separate research section should be attached to the Cotton Technological Laboratory, India General Cotton Committee, Bombay for tackling research problems of the industry. An adequate grant should be sanctioned for this purpose. The Government should also give annual grants to the existing hosiery institute at Ludhiana (Punjab). Cawnpore (U.P.), Serampore (Bengal) where facilities for training of technical personnel for this industry already exist.

12. The Panel considers that the existing cottage induetry system may be suitably adjusted with the aid of co-operative organisations and with the introduction of improved appliances and machinery for the development of this industry in the near future. When Government electrification plans nature and cheap electric power is available in the rural and urban areas and where cheap hydal power is already obtainable, this industry can in fact thrive on a cottage industry basis.

13. The Panel strongly recommends that hosiery manufacturers should form themselves into an association for the development of this industry particularly with regard to fixing specifications and grades of products for internal and export markets.

H.G. Misra, Chairman.
A.W. Tatlow.
W. Firth.
Fakhruddin.
A.K. Choudhuri.
H.R. Dhanda
Member.

A. S. Bhatnagar Secretary.

STATEMENT NO. I., SHOWING IMPORTS OF HOSIERY (COTTON) WITH PRICES (KNITTED FABRICS).

	QUANTITY IN lbs.					VALUE IN Rs.				
	1936-37	1937-38	1938-39	1939-40	1940-41	1936-37	1937-38	1938-39	1939-40	1940-41
United Kingdom (inbluding Channel Islands)	5,372	7,046	6,424	8,661	5,012	9,039	12,214	11,679	20,432	15,579
Buarma.	...	9,925	...	2,205	1	...	8,196	...	8,896	9
Oth er British Possessions.	...	...	2,705	752	...	...	...	4,785	1,239	...
TOTAL BRITISH EMPIRE.	5,372	16,971	9,129	11,618	5,013	9,039	20,410	16,464	30,567	15,588
Japan.	8,085	23,097	22,459	44,277	32,939	6,050	22,011	21,563	56,515	54,058
Other Foreign Countries ...	251	82	879	2,463	2,225	228	110	3,489	4,233	3,709
TOTAL FOREIGN COUNTRIES. ...	8,336	23,179	23,338	46,740	35,164	6,278	22,121	25,052	60,748	57,767
Share of Bengal. ...	3,514	19,041	11,275	9,778	5,132	4,891	22,110	17,132	14,616	10,681
Share of Bombay...	9,864	20,963	20,781	46,491	34,602	9,974	20,244	23,508	70,770	59,614
Share of Sind. ...	20	82	—	89	—	11	110	—	149	—
Share of Madras. ...	310	64	411	2,000	443	441	67	876	5,780	3,060
TOTAL. ...	13,708	40,150	32,467	58,358	40,177	15,317	42,531	41,516	91,315	73,355

STATEMENT NO. II. SHOWING IMPORTS OF HOSIERY (COTTON). STOCKINGS & SOCKS.

	QUANTITY IN DOZ.					VALUE IN Rs.				
	1936-37	1937-38	1938-39	1939-40	1940-41	1936-37	1937-38	1938-39	1939-40	1940-41
	Doz. Pairs	Doz. Pairs	Doz. Pairs	Doz. pairs	Doz. pairs					
United Kingdom (including Channel Islands) ...	6,035	6,567	5,010	4,270	1,718	35,269	30,563	25,467	26,672	17,230
Hongkong ...	14,408	36,512	3,388	7,315	6,009	15,012	28,500	2,889	4,996	7,775
Commonwealth of Australia ...	...	1	562	3	8	...	7	5,292	18	76
Other British Possessions ...	17	917	1,952	413	2,750	25	1,484	2,523	565	4,843
TOTAL BRITISH EMPIRE ...	20,460	43,997	10,912	12,001	10,485	50,306	60,554	36,171	32,251	29,924
Germany ...	8,331	4,845	5,494	1,671	...	63,015	37,528	40,312	13,380	...
Czechoslovakia ...	3,163	72,659	48,301	93,688	...	2,498	26,573	14,213	18,527	...
Japan ...	526,295	802,838	...	333,011	151,384	508,300	938,886	421,715	305,789	230,439
China (exclusive of Hongkong & Macao)	14,269	1,324	1,488	12,314	133,632	8,752	1,349	1,382	13,446	175,500
United States of America										
Via. Atlantic Coast	8,598	7,672	6,941	3,843	6,781	47,886	44,704	40,803	24,416	49,589
,, Pacific ,,	..	—	...	—	...	..	2	...	...	...
Other Foreign Countries ...	190	241	129	260	76	1,023	1,537	1,046	1,673	498
TOTAL FOREIGN COUNTRIES ...	560,846	889,579	459,539	444,787	291,873	631,474	10,50,579	519,471	377,231	456,026

STATEMENT NO. II. SHOWING IMPORTS OF HOSIERY (COTTON). STOCKINGS & SOCKS.

	QUANTITY IN DOZ.					VALUE IN RS.				
	1936-37	1937-38	1938-39	1939-40	1940-41	1936-37	1937-38	1938-39	1939-40	1940-41
	Doz. Pairs	Doz. Pairs	Doz. Pairs	Doz. Pairs	Doz. Pairs					
Share of Bengal ...	233,228	387,123	166,718	181,610	91,320	250,379	397,532	137,558	110,520	156,805
Share of Bombay ...	221,036	371,350	214,837	190,252	167,545	288,481	495,636	313,051	209,122	263,221
Share of Sind ...	98,611	171,481	82,863	82,632	41,252	109,013	212,454	98,240	87,006	604,175
Share of Madras ...	2,742	3,617	6,033	2,294	2,241	1,808	5,511	6,793	2,834	1,749
Share of Burma ...	25,689	...	...	...	...	32,099	...	...	...	...
Dozen Pairs lbs. ...	581,306	933,576	470,451	456,788	302,358	681,780	11,11,133	555,642	409,482	485,950
TOTAL ...	416,339	667,125	286,081	237,664	206,094					

STATEMENT No. III. SHOWING IMPORTS OF HOSIERY (COTTON) Under Wear.

UNDERWEAR.	QUANTITY IN DOZ.					VALUE IN Rs.				
	1936-37 Doz.	1937-38 Doz.	1938-39 Doz.	1939-40 Doz	1940-41 Doz.	1936-37	1937-38	1938-39	1939-40	1940-41
United Kingdom (including Channel Islands.)	5,857	4,220	3,231	3,469	2,629	43,928	31,935	23,828	34,013	30,049
Aden and Dependencies.	...	...	...	...	1,499	...	...	...	...	5,453
Burma.	...	5,771	14,983	3,518	26,107	...	27,603	72,161	24,432	1,75,622
Hongkong.	8,571	271	380	747	665	51,527	2,564	3,122	6,573	8,145
Other British Possessions.	1,243	214	42	1,022	5	4,932	1,225	87	3,038	44
TOTAL BRITISH EMPIRE.	15,671	10,476	18,636	8,756	30,905	1,00,387	63,327	99,108	68,056	2,19,313
Germany.	3,236	2,087	746	289	...	31,238	14,266	9,705	4,237	...
Japan.	8,96,751	5,39,423	3,49,694	1,95,716	2,28,240	17,80,293	11,06,937	6,98,273	3,53,993	5,89,983
China (Exclusive of Hongkong & Macao.)	1,055	465	408	1,964	1,245	8,281	1,983	2,230	3,918	7,200
United States of America										
Via. Atlantic Coast.	539	795	379	820	1,530	4,805	7,309	4,233	8,970	19.160
,, Pacific ,,	...	...	...	430	426	...	...	...	5,754	5 972
Other Foreign Countries.	72	84	147	12	6	269	1,402	718	344	83
TOTAL FOREIGN COUNTRIES.	9,01,653	5,42,854	3,51,374	1,99,231	2,31,447	18,24,886	11,31,897	7,15,159	3,77,216	6,22,398

STETEMENT No. III. SHOWING IMPORTS OF HOSIERY (COTTON) Under Wear.

UNDERWEAR.	QUANTITY IN DOZ.					VALUE IN Rs.				
	1936-37 Doz.	1937-38 Doz.	1938-39 Doz.	1939-40 Doz.	1940-41 Doz.	1936-37	1937-38	1938-39	1939-40	1940-41
Share of Bengal ...	3,42,458	1,97,673	1,33,956	41,930	1,10,705	7,23,894	4,09,105	3,39,454	1,48,777	4,84,065
Share of Bombay ...	1,60,584	2,47,133	1,05,475	80,367	90,066	2,48,075	4,39,880	2,07,566	1,27,039	1,98,592
Share of Sind. ...	1,19,845	97,552	1,15,329	85,455	60,734	2,29,671	2,63,302	2,36,645	1,67,070	1,54,917
Share of Madras ...	9,387	10,972	15,250	235	847	16,593	22,937	30,692	2,386	4,137
Share of Burma. ...	2,85,050	... ...	... ...	... ...	... ...	7,07,040	—	...	...	...
Total.....Doz.	9,17,324	5,53,330	3,70,010	2,07,987	2,62,352	19,25,273	11,95,224,	8,14,357	4,45,272	8,41,711
Lbs.	17,27,451	8,91,947	6,12,133	3,26,510	4;81,977	...	—	...	...	...

STATEMENT No. IV SHOWING IMORTS OF HOSIERY (COTTON) OTHER SORTS.

	QUANTITY. IN lbs.					VALUE IN Rs.				
	1936-37	1937-38	1938-39	1939-40	1940-41	1936-37	1937-38	1938-39	1939-40	1940-41
United Kingdom (including Channel Islands).	...	...	...	...	...	32,544	34,947	49,612	42,438	36,012
Burma	...	...	...	...	...	...	60,841	46,228	68,925	89,493
Hongkong	...	...	...	...	...	12,559	50	1,663	5,363	434
Other British Possessions	...		...	...		127	752	657	1,288	40
TOTAL BRITISH EMPIRE	...	...	...	...	...	45,230	96,590	98,160	118.014	125,979
Germany	...	...	...		...	2,880	5,883	6,021	5,931	...
Japan	...	...	...	...	...	596,256	440,680	218,387	150,140	235,329
United States of America Via. Atlamtic	...	...	...	...	...	2,653	6,994	15,520	20,084	16,221
United States of America Via. Pacific Coast	...	...	...	...	...	...	7	172	705	531
Other Foreign Countries.	...	...	...	...	...	1,782	5,400	3,275	1,436	3,098
TOTAL FOREIGN COUNTRIES	...	...	...	...	...	603.571	458,964	243,375	178,296	255,179
Share of Bengal	...	...	...	...	...	218,579	329,896	138,201	184,999	109,398
Share of Bombay	...	...	...	...	...	126,522	197,478	187,008	102,538	261,838
Share of Sind	...	...	...	...	...	18,110	1,681	...	...	28
Share of Madras	...	...	...	...	...	6,687	26,499	16,326	8,773	9,894
Share of Burma	...	...	...	...	...	278,903	...	...	...	...
TOTAL	...	...	...	...	...	648,801	555,554	341,535	296,310	381,158

STATEMENT No. V. SHOWING GENERAL EXPORTS OF HOSIEY (COTTON).

	QUANTITY.					VALUE IN Rs.				
	1936-37	1937-38	1938-39	1939-40	1940-41	1936-37	1937-38	1938-39	1939-40	1940-41
Aden & Dependencies ...	...	...	...	...	...	7,580	5,891	3,000	3,230	687
Ceylon ...	...	...	...	...	...	4	725	898	2,017	41,154
Burma ...	...	...	...	...	...	...	25,484	64,612	4,55,091	2,99,194
Sierra Leone ...	...	...	...	...	...	...	9,620	450	500	11,695
Gold Coast (including British Mandated Territory of Togoland. ...	...	...	...	...	...	...	1,450	...	5,300	10,850
Nigeria (including British Mandated Territory of Cameroons. ...	...	...	...	...	...	7,012	1,310	4,940	15,890	52,090
Kenya Colony ...	...	...	...	...	...	1,380	8,255	3,510	13,573	77,197
Tanganyika Territory	...	...	...	...	...	...	2,100	2,850	2,000	11,749
Nyasaland Protectorate ...	...	...	...	...	...	...	...	...	...	8,075
Canada Via. Atlantic Coast. ...	...	...	...	...	...	...	9,240	...	...	...
British West India Islands. (Excluding Bahamos) ...	...	...	...	...	...	...	...	...	...	5,019
Other British Possessions. ...	...	...	...	...	...	5,676	9,385	8,617	12,997	21,832
TOTAL BRITISH EMPIRE.	...	...	...	...	...	21,652	73,460	88,877	5,10,618	5,39,542

STATEMENT No. V. SHOWING GENERAL EXPORTS OF HOSIEY (COTTON).

	QUANTITY					VALUE IN Rs.				
	1936-37	1937-38	1938-39	1939-40	1940-41	1936-37	1937-38	1938-39	1939-40	1940-41
Germany	...	...	...	...	...	...	...	...	7,345	...
Portuguese East Africa	10,125	30,610	17,740	440	4,144					
Other Foreign Countries	6,692	6,776	3,230	6,038	4,361					
TOTAL FOREIGN COUNTRIES.	16,817	37,386	20,970	13,823	8,490					
Share of Bengal	720	17,139	65,929	4,37,129	2,83,974					
Share of Bombay	32,425	91,553	42,407	82,277	2,05,669					
Share of Sind	2,220	1,465	850	2,444	4,305					
Share of Madras	3,100	689	661	2,581	54,674					
Share of Burma.	4	...	...	...	...					
TOTAL	38,469	1,10,846	1,09,847	5,24,441	5,48,022					

STATEMENT NO. VI. SHOWING IMPORTS OF HOSIERY WOOLLEN KNITTED APPAREL.

	QUANTITY.					VALUE IN Rs.				
	1936-37	1937-38	1938-39	1939-40	1940-41	1336-37	1937-38	1938-39	193-9-40	1940-41
	in. lbs.	in. lbs.	in. lbs.	in. lb	ln. lbs.					
United Kingdom including Channel Islands.	45,895	29,795	46,840	26,927.	17,162	2,16,457	1,83,222	2,49,975	1,74,271	1,6,860
Burma ...	...	13,882	...	516	199	...	34,283	...	1,682	452
Hongkong ...	2,701	...	21	192	323	5,356	...	47	557	1,206
Other Brititish Possessions.	227	308	344	451	573	226	524	649	838	3,654
TOTAL BRITISH EMPIRE ...	48,823	43,985	47,205	28,086	18,257	2,22,039	2,18,029	2,50,671	1,77,348	1,42,172
Germany ...	2,680	3,655	3,454	1,020	...	18,743	22,918	25,240	9,015	...
Japan ...	3,03,585	2,10,856	2,15,405	1,58,624	56,804	7,68,230	6,29,124	6,31,315	4,16,232	2,27,593
China (exclusive of Hong-Kong and Macao).	264	561	334	3,097	1,049	347	1,185	833	5,304	3,621
Other Foreign Countries.	904	609	1,329	1,046	940	2,293	2,250	5,490	4,143	6,118
TOTAL FOREIGN COUNTRIES	3,07,433	2,15,681	2,20,522	1,63,787	58,793	7,89,613	6,55,477	6,62,878	4,34,694	2,37,332
Share of Bengal ...	1,36,922	1,61,438	1,45,621	87,366	33,910	3,63,472	5,27,806	4,76,892	2,67,526	1,62,746
Share of Bombay ...	67,139	67,993	93,708	65,184	35,799	2,28,180	2,40,412	3,30,209	2,30,315	179,555
Share of Sind ...	26,193	29,658	27,589	37,401	6,674	77,013	1,02,860	1,02,646	1,04,184	32,000
Share of Madras ...	1,110	577	809	1,922	667	3,064	2,428	3,802	10,017	5,203
Share of Burma ...	1,24,892	...	...	...	...	...	...	...	...	...
TOTAL ..	3,56,256	2,59,666	2,67,727	1,91,873	77,050	10,11,652	8,73,506	9,13,549	6,12,042	3,79,506

STATEMENT VII SHOWING IMPORTS OF HOSIERY (WOOL) AND OTHER SORTS.

	QUANTITY IN LBS.					VALUE IN Rs.				
	1936-37	1937-38	1938-39	1939-40	1940-41	1936-37	1937-38	1938-39	1939-40	1940-41
United Kingdom (including Channel Islands.) ...	70,974	78,483	76,697	50,386	21,226	3,11,222	3,86,215	3,60,904	2,59,966	1,66,511
Burma. ...	..	3,920	1,213	698	...	...	12,147	2,700	1,927	...
Other British Possessions. ...	70	3	702	24	399	316	15	1,648	46	2,870
Total British Empire.	71,044	82,406	78,612	51,108	21,625	3,11,538	3,98,377	3,65,252	2,61,939	1,69,381
Japan. ...	38,395	33,913	20,389	27,517	7,035	1,23,826	1,22,119	61,475	87,478	31,474
Other Foreign Countries. ...	440	577	1,034	1,477	37	1,948	3,520	6,991	6,692	408
Total Foreign Countries. ...	38,835	34,490	21,423	28,994	7,072	1,25,774	1,25,639	68,466	94,170	31,882
Share of Bengal ..	27,182	31,030	29,109	15,917	8,057	1,12,999	1,34,244	1,28,503	81,547	58,254
Share of Bombay ..	41,033	43,706	35,811	37,673	14,272	1,46,978	1,87,747	1,41,647	1,54,125	89,175
Share of Sind. ...	39,326	39,545	32,960	25,200	5,354	1,65,318	1,87,383	1,51,577	1,12,134	45,172
Share of Madras.	2,045	2,615	2,155	1,312	1,014	10,319	14,642	11,991	8,303	8,662
Share of Burma. ...	293	...	...	...	...	1,698	...	...	...	...
TOTAL. ..	109,879	116,896	100,035	80,102	28,697	4,37,312	524,016	433,718	356,109	201,263

STATEMENT No. VIII SHOWING IMPORTS OF HOISERY (SILK.)

Hoisery-Socks & Stockings made Chiefly of Silk.	QUANTITY					VALUE IN Rs.				
	1936-37	1937-38	1938-39	1939-40	1940-41	1936-37	1937-38	1938-39	1939-40	1940-41
United Kingdom-	lbs.	lbs.	lbs.	lbs.						
(including	=Doz. Pair	=Doz. Pair	=Doz. Pair	=Doz. Pair	=Doz. Pair					
hennel Islands),	1,473	2,048	1.652	1,401	1,220	19,477	34,072	27,441	22,685	26,343
	= 1,428	= 2,092	= 1,901	= 1,435	= 1,124					
anada Via. Atlan-	236	382	130	768	538					
tic Coast.	= 232	= 441	169	= 651	= 559	3,822	7,616	3,371	12,843	12,580
	61	...	7	3	6					
Other British-										
Possessions.	= 23	...	7	= 3	= 18	448	...	81	23	592
TOTAL BRITISH	1,770	2,430	1,789	2,172	1,764					
EMPIRE.	= 1,683	2,533	= 2,077	= 2,089	= 1,701	23,747	41,688	30,593	33,555	39,515
Germany.	497	636	89	16	...	2,674	6,594	1,256	137	...
	= 231	= 642	= 124	17						
Czecho-slovakia.	1,589	1,273	1,301	534	...	6,458	9,111	10,937	8,377	...
	= 794	= 2,034	= 7,774	= 1,812	...					
Japan.	1,202	802	356	60	118	6,199	8,595	3,849	1,097	3,523
	= 1,664	= 913	= 344	= 89	= 191					
United States of										
America	4,285	3,438	3,146	3,225	3,707	66,845	58,504	47,104	53,591	66,956
Via. Atlantic Coast	= 4,430	= 3,676	= 2,910	= 3,187	= 3,812					
" Pacific "	...	...	...	...	141	...	...	...	...	4,587
Other Foreign	117	20	164	20	452	1,182	453	784	213	2,822
Countries.	143	13	123	21	543	...	...	...	...	...
TOTAL FOREIGN	7,690	6,169	5,056	3,855	4,418	83,358	83,257	63,930	63,415	77,888
COUNTRIES.	= 7,262	= 7,278	= 11,275	= 5,126	= 4,753					

STATEMENT No. VIII SHOWING IMPORTS OF HOISERY (SILK.) (Contd.)

Hoisery-Socks & Stockings made Chiefly of Silk.	QUANTITY					VALUE IN Rs.				
	1936-37	1937-38	1938-39	1939-40	1940-41	1936-37	1937-38	1938-39	1939-40	1940-41
Share of Bengal.	4,587 = 3,698	3,982 = 4,990	3,249 = 9,758	2,071 = 3,480	1,948 = 2,227	44,778	48,076	42,388	36,747	44,303
Share of Bombay.	2,92,943 = 3,383	3,101 = 3,320	2,808 = 2,761	2,186 = 2,142	2,824 = 3,111	35,733	51,225	39,546	34,678	49,755
Share of Sind.	920 = 856	1,500 = 1,482	510 = 554	1,279 = 1,119	1,086 = 755	13,211	25,359	8,560	20,240	14,710
Share of Madras.	23 = 19	16 = 19	278 = 279	491 = 474	324 = 361	139	285	4,329	7,305	8,635
Share of Burma.	987 = 989	... = ...	...	...	...	10,244	...	...	...	...
TOTAL	9,460 = 8,945	8,599 = 9,811	6,845 = 13,352	6,027 = 7,215	6,182 = 6,454	107,105	124,945	94,823	98,970	117,403

STATEMENT NO. IX. SHOWING IMPORTS OF HOSIERY (ARTIFICIAL SILK)

Hosiery—Socks and Stockings made entirely of Artificial Silk.	QUANTITY.					VALUE IN Rs.				
	1936-37	1937-38	1838-39	1939-40	1940-41	1936-37	1937-38	1938-39	1939-40	1940-41
	lbs. Doz. Pairs	lbs. Doz. Pairs	lbs. Doz. Pairs	lbs. Doz. Pairs						
United Kingdom including inChannel Islands.	6,695	8,109	5,363	4,140	5,460	33,819	41,011	28,391	23,769	37,186
	= 6,395	= 7.537	= 5,430	= 4,381	4,681					
Other British Empire	593	2,355	354	81	1,111	640	4,329	1,363	156	3,9583
	= 585	= 1,751	= 484	= 55	= 1,501					
TOTAL BRITISH EMPIRE.	7.288	10,464	5,717	4,221	6,571	34,459	45.340	29,754	23,925	41,139
	6,980	9,288	5,914	4,436	6,182					
Germany ...	3,160	3,438	1,235	368	...	20,474	24,996	10,355	2,681	...
	= 2,482	= 3,188	= 1,200	= 296						
Czechoslovakia ..	1,881	14,233	4,559	2,558	...	11,151	57,767	13,111	10,478	...
	= 1,303	13,841	1,911	5,545						
Japan ...	145,667	=382,747	= 188,063	102,860	32,725	228,668	659,453	978	153.978	76,640
	= 188,036	=538,559	= 252,137	= 143,489	= 46,313					
China (exclusive of Hongkong & Macao	4	20	84	1,922	14,906	10	108	250	4,198	40,584
	= 2	= 27	= 102	= 2,532	28,410					
United States of America Via. Atlantic Coast ...	1,477	3,442	2,256	2,006	3,983	10.654	22,939	14,092	12,737	31,000
	1,316	= 3,050	= 1,999	= 1,595	= 3,916					
Via. Pacific Coast	...	2	..	57	...	...	15	...	57	...
	=	2	=	= 8						
Other Foreign Countries ...	176	387	249	458	...	844	2,134	922	1,638	..
	= 140	= 369	= 280	= 609	=					
TOTAL FOREIGN COUNTRIE ...	152,365	404,269	196,446	110,179	51,614	271,801	767,412	297,708	185,767	148,224
	= 193,279	= 559,036	= 257,629	= 154,078	= 78,639					

STATEMENT NO. IX. SHOWING IMPORTS OF HOSIERY (ARTIFICIAL SILK) (Contd.)

Hosiery—Socks and Stockings made entirely of Artificial Silk.	QUANTITY.					VALUE IN Rs.				
	136-37	137-38	138-39	139-40	140 41	136-37	137-38	138-39	139-40	140-41
Share of Bengal ...	84,119	200,184	103,629	59,627	25,786	129,196	358,612	150.950	113,385	84,790
	= 101,714	= 260,435	= 133,847	= 86,106	= 45,292					
Share of Bombay ...	55,253	172,996	69,921	33,940	23,471	128,839	365,166	128.644	63,705	78,717
	= 72,727	= 252,220	= 92,455	= 43,161	= 26,517					
Share of Sind ...	16,349	40,210	27,272	20,525	8,729	37,905	85,728	44,288	30,670	23,538
	= 21,118	= 54,442	= 35,723	29,003	= 12,657					
Share of Madras ...	664	1,343	1,341	308	199	1,954	3,246	3,580	1,932	2,318
	= 726	1,227	= 1,518	244	= 355					
Share of Burma ..	= 3.268	...	...	...	...	8,366	—	...	...	...
	3,974	...	...	...	...	—	...	...	...	—
TOTAL ...	159,653	414,733	202,163	114,400	58,185	306,260	812,752	327,462	209,692	189,363
	200,259	= 568,324	= 263.547	= 158,514	= 84.821					

STATEMENT NO. X SHOWING IMPORT TARIFF ON HOSIERY.

Year.	Name of Articles.	Tariff Values.	Standard rate of duty.	Preferential rate of duty if article manufaoture of	
				U. K.	Br. Colony.
1934 Jan.	A. Cottonn Hosiery	Ad. Valorem.	25 Percent	...	...
	B. Woollen Hosiery	,,	35 Percent	25 Percent.	...
1934 May.	A. (i) Cotton hosiery, the following mainly, Cotton undervests, knitted or woven & Cotton Socks or Stockings	,,	25 Percent or -/12/- per lb. which ever is higher.	...	...
	(ii) Cotton knitted fabrics.	,,	50 Percent or -/12/- per lb. whichever is higher.	...	...
	(iii) Cotton hosiery etc., not otherwise specified.	,,	35 Percent.	25 Percent.	25 Percent.
	B. Woollen Hosiery & woollen knitted apparel that is to say all hosiery & knitted apparel containing not less than 15% of woollen by weight.	,,	35 Percent or Rs. 1-2-0 per lb. whichever is higher.	25 Percent.	...

NATURE OF DUTY.

Year.	Name of Articles.	Tariff Values.	Standard rate of duty.	Preferential rate of duty if article manufacture of	
				U. K.	Br. Colony.
1935 Jan.	A. (i) Cotton hosiery the following namely, Cotton undervests, knittled or woven & Cotton Socks or Stockings.	Protective	25 Present Ad. Valorem, or -/12/- per lb. which ever is higher.	...	...
	(ii) Cotton knitted fabrics	,,	50 Percent Ad. Valorem, or -/12/- per Lb. which ever is higher.	...	...
	(iii) Cotton hosiery etc. not otherwise specified.	Preferential Revenue.	35 Percent Ad. Valorem.	25 Percent Ad. Valorem	25 Percent Ad. Valorem
	B. Wollen hosiery & woollen knitted apparel that is to say all hosiery & knitted apparel containning not less than 15% of wool by weight.	Ditto	35 Percent Ad. Valorem, Rs. 1-2-0 per Lb. whichever is higher.	Ditto	...

NATURE OF DUTY. (Contd,)

Year.	Name off Articles.	Tariff Values.	Standard rate of duty.	Preferential rates of duty if article manufacture of	
				U. K.	Br. Colony.
1936 May.	A. (i) Cotton knitted or woven undervests & Cotton Socks or Stockings— (a) of a weight not exceeding 4 Lbs., per Doz.	Protective	25 Percent Ad. Valorem, or -/12/- per lb., whichever is higher.	..	...
	(b) of a weight exceeding 4 Lbs., per Doz.	,,	25 percent Ad. Valorem or -/10/- per Lb., whichever is higher.	...	...
	(ii) Cotton knitted fabrics	,,	50 Percent Ad. Valorem, or -/12/- per Lb., whichever is higher.	...	...
	(iii) Cotton hosiery not otherwise specified.	Preferential Revenue.	35 Percent Ad. Valorem	25 Percent Ad. Valorem	25 Percent Ad. Valorem.
	B. Woollen hosiery & woollen knitted apparel that is to say all hosiery & knitted apparel containing not less than 15% of wool by weight.	,,	35 Percent Ad. Valorem, or Rs. 1-2-0 per Lb., whichever is higher.	25 Percent Ad. Valorem	

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CONFIDENTIAL

GOVERNMENT OF INDIA

PLANNING & DEVELOPMENT DEPARTMENT

OFFICE OF THE INDUSTRIAL ADVISER

REPORT OF THE PANEL
ON
SUGAR, ALCOHOL & FOOD YEAST INDUSTRIES

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REPORT OF THE PANEL ON SUGAR, ALCOHOL AND FOOD YEAST.

A Panel was formed by the Government of India in the Department of Planning and Development to consider and make recommendations to them regarding the development of Sugar, Alcohol and Food Yeast Industries. The Panel consisted of the following :—

Sir Shri Ram (Chairman).

Mr. R. C. Srivastava, C.I.E.

Mr. Vishnu Sahay, I.C.S.

Mr. S. M. Dhar, C.I.E., I.C.S.

Dr. B. C. Guha, D. Sc., Ph. D.

Mr. Lalchand Hirachand.

Mr. M. B. Amin, Dipl. Ing.

Mr. W. H. A. Webb, B.Sc., A.M.I. Chem., E.

Dr. M. K. Maitra, Ph. D., D.I.C. (Secretary)

Messrs Shankar Prasad, I.C.S., Karam Chand Thapar and Gur Sharan Lal were subsequently co-opted as members of the Panel.

2. The following general and special directives were issued by the Government of India to indicate the scope of the panel and the procedure to be followed by it :—

GENERAL DIRECTIVE.

"It is the function of Panels to make recommendations to Government regarding the development of industries, both existing and new. These recommendations should be so framed as to enable Government to prepare a detailed phased plan for the five years following the cessation of hostilities as the first stage of a 15-year plan of industrial development for the whole country.

2. In order to assist them to formulate recommendations, Panels will be supplied, as far as possible, with factual information prepared by the Panel Secretaries. In the case of new industries, the information will consist of a general survey of the industry and the importance of starting it in India, the availability of raw material, the power requirements, the demands of the Indian markets and the probabilities of exports. In the case of existing industries, the information will naturally be more comprehensive ; it will indicate, in addition, the location of existing units, the types of goods produced, the total production under each category and the assistance, if any given by Government. These items are to be regarded as illustrative and not exhaustive.

Government will give each Panel, as a basis, for discussion the provisional target to be aimed at in the first 5-year period and, wherever possible, of the target to be reached in 15 years.

3. The recommendations of the Panels should cover the following points :—

(1) The scope and extent of development, including the type of products recommended.

(2) Whether the industry should be under Government ownership either on ground of national interest or because private capital is unlikely to take it up, and if so whether it should be wholly or partly managed by Government.

(3) In the case of industries to be developed other than under State ownership, the capital required for such development, whether the whole of it is likely to be available by public investment and, if not, the extent to which Government assistance may be required.

(4) The extent to which technical advice from abroad may be necessary.

(5) The manner and the degree of co-operation with foreign firms considered necessary and desirable, both as regards capital and management.

(6) The location of the industry.

(7) The nature of the assistance required from Government in the form of protective duties, bounties, research grant, expert advice, etc.

(8) If the industry is to be under private ownership and management, what controls, if any, should be exercised by Government.

(9) What should be the organisation of the different units of the Industry, e.g., should there be an indusdtrial association ? Would a cartel be desirable ?

(10) The stages by which the industry should be developed.

(11) Should the industry cater for the export market ?

(12) Should the industry be developed, as in Japan, on the cottage industry basis and if so, to what extent.

4. Although, as stated above, the Panels may recommend the grant of protection, it will not be their function to consider broad questions of international trade and commercial policy.

5. Joint meetings of the Panels should be held, wherever necessary, to secure co-ordination, particularly where the processes and the products of one industry are connected with those of another.

6. Some of the panels have been drawn broadly and it may be necessary to co-opt members for dealing with specific branches of the industry. Members may be co-opted by the Chairman in consultation with the Industrial Adviser.

7. Before submitting recommendations, Panels should consult Provincial Industrial Committees, particularly in the matter of location of industry. They should also, where the circumstances of the case require it, consult Industrial Committees in States or State Governments Durbars. The recommendations should be submitted to Government through the Industrial Adviser ".

SUPPLEMENTARY DIRECTIVE.

" This directive is supplementary to the general directive to Panels.

The provincial target to be aimed at in the first five-year period and the targets to be reached in fifteen years are indicated below :—

Five-year period.

Sugar	...	... (25 % over existing production).
Power alcohol	...	... (20 million gallons).
Food Yeast	...	... (Not yet fixed).

In addition to the points mentioned in para 3 of the general directive, the recommendations of the panel should cover the following matters :—

(i) Whether the panel agrees to the appointment of an expert adviser (or Commissioner) with a comprehensive experience of the power alcohol industry to assist and advise Government.

(ii) Whether the Panel agrees to the appointment of an experienced firm or firms as Consultants for the power alcohol industry.

(iii) The possibility of producing power alcohol from sources other than molasses.

(iv) The best method of distributing the power alcohol produced, so as to make the fullest possible use of it.

(v) whether the sugar industry is over developed at present in any region, if so, whether the Panel has any suggestion on the subject.

(vi) What steps should be taken to make the Sugar industry efficient enough to be able to compete with Java in the export market.

(vii) Whether the Panel considers that the industry can stand on its own legs without a reduction in the present excise duty.

(viii) The possibility of manufacturing in India the Capital goods, particularly machinery required by the Sugar, Alcohol and Food Yeast industries."

3. Preliminary notes on the Sugar Industry, Power Alcohol and Food Yeast were prepared and circulated amongst the members of the Panel before its first meeting.

4. The meetings of the Panel were held on the following days :—

The first meeting was held on the 21st May 1945 ;

The second meeting was held on the 9th & 10 July 1945 ;

The third meeting was held on the 13th & 14th August 1945.

On the morning of the 14th August a joint meeting of the Panel with the Agricultural Sub-committee of the Indian Sugar-cane Committee was held.

A draft report of the Panel was drawn up and this was taken up for consideration at the fourth meeting of the Panel held on the 4th Januarty 1946.

The draft report of the Panel was forwarded to the Provincial Governments and the major Indian States. At a joint meeting of the Panel with the representatives of the Provincial and State Governments and their Industrial committees held on the 7th February 1946, the various recommendations embodied in the draft report were fully discussed.

The fifth and final meetings of the Panel were held on the evening of the 7th February and on the 8th February, 1946.

5. The Panel is grateful to the Chairman for his able guidance of the deliberations at the meetings and for his constant interest and valued advice.

The Panel is greatly obliged to several officials and non-officials who have helped it with information and advice. It would not be possible to name them all individually. The Panel would, however, like to express its special obligations to Mr. S. Dikshit, officiating Sugar Controller for India, for the co-operation and valuable help he has rendered to the Panel.

THE SUGAR INDUSTRY.

6. The history of the modern Sugar Industry in India virtually begins from 1932 when the Government of India adopted a policy of giving tariff protection to it. In 1931-32 there were only 31 vacuum pan factories in India and they produced 1,58,000 tons of sugar. Now there are 154 with a normal production of 10,80,000 tons.

7. **Comsumption before the war and now.**—Before the war India had become self-sufficient in respect of its sugar requirements ; indeed in certain years production was in excess of these. Imports were small and were mainly confined to maritime states. The average annual demand for internal consumption was 10,80,000 tons. It has since grown considerably owing to the general growth of population, the increase in industrial and urban population and improvement in war-time in the purchasing power of at least a section of the population, with consequent changes in their standard of living and habits. To these causes will soon be added the general impact on rural habits of the return of two million soldiers. The estimates made by the Governments of provinces and states and the Sugar Controller for India show that the present effectiv demand for sugar is about 50 per cent. higher than in 1939. This is further substantiated by certain figures supplied by the Director, Cost of living Index, of the Labour Department of the Government of India about family budgets of working classes in urban areas. These indicate that the per capita consumption of sugar by these classes has during the war-time increased by about 60 per cent. It is, therefore, safe to assume that the internal demand in the country will in 1950 be 15,50,000 tons. This quantity would then provide roughly 24 lbs. per head per annum

for towns with a population of more than 5,000 and 6 lbs. for the rest of the country. The pre-war average consumption was over 6 lbs. per head and the figures of off-take in the towns which are rationed at present indicate that though consumption will vary widely from town to town and area to area, the above estimate of the roverall demand is not too liberal. It, however, postulates that there will be no slump in the economy of the country, which is a premise we must accept for the purpose of our planning.

8. Exports.—It is desirable to have a normal annual provision of 50,000 tons for export to neighbouring countries. It is true that the cost of production of sugar in India is, at present, higher than in Java, our chief competitor. But we need export markets as a safety-valve for years of over production and, for that reason, to maintain contact with them, even though export may be possible only at low prices and, therefore, at some cost to the local consumer. India should guard itself against a recurrence of the position in pre-war years when an International Agreement debarred it from exporting sugar on the ground that it was normally not in a position to do so. But for this restriction it might have been possible for the industry in U. P. and Bihar to face the crisis due to overproduction in 1940 with lesser inconvenience to itself and the cane-growers. Further it is likely that as a result of improved agriculture and better efficiency in production we should, by the time we do have an exportable surplus, be producing sugar cheaper than at present.

9. Production target.—It is, therefore, necessary to plan for an annual production of 16,00,000 tons for the period ending 1950. Considering the difficulties in estimating the social and economic conditions and the growth of population over a longer period, it would at present be safe and desirable to plan for only five years.

10. Present production capacity.—The theoretical production capacity of the existing vacuum-pan factories manufacturing sugar directly from cane is over 14,00,000 tons but the maximum production in any year was only 12,42,000 tons. The following figures show the average annual production in U. P. and Bihar during the years 1937-38 to 1943-44 (excluding 1940-41 and 1941-42 when production in these provinces was artificially restricted) and in other areas from 1939-40 to 1943-44 :—

	Tons.
United Provinces	5,70,000
Bihar	2,31,000
Madras	35,000
Punjab	11,000
N.W.F.P.	5,000
Sind	3,000
Orissa	2, 000
Bombay	80,000
Bengal	29,000
Indian States	1,18,000
	10,84,000

The normal capacity of the Indian Sugar Industry with its present location, equipment and efficiency and under existing conditions of agricultural economy and transport for sugarcane is, therefore, about 10,80,000 tons. It is expected, however, that by 1950 it will by development of sugarcane, construction of roads in factory areas, shifting of certain units to more suitable sites, and improvement in manufacturing efficiency, increase by 1,70,000 tons to 12,50,000.

11. Refineries producing sugar from cane gur & Palmyra Jaggery. —There are some factories which produce white sugar by refining cane gur or Palmyra Jaggery. Their production in the past has been fitful and they have worked only in years in which the prices of Gur or Palmyra Jaggery were unduly low. The cane gur refineries have practically produced no sugar for some years. Those refining Palmyra Jaggery, not having to pay any excise duty, have done somewhat better. The total production during the last three years has averaged about 8000 tons annually and there is no prospect of any improvement in future. The production from this source, need not, therefore, be taken into account. Sugar produced by refining Palmyra Jaggery is at present exempted from the excise duty. The Panel is not clear what the justification now is for continuing this exemption.

12. Khandsari.—Accurate statistics regarding the production of Khandsari sugar are not available, but its average annual production during the recent years may be fairly assumed to be 75,000 tons. Khandsari is a wasteful process of producing sugar and the quality of the product is generally inferior. It a relic of the past. Until lately there was a special demand for it among certain orthodox classes and in backward areas, but that has now almost entirely disappeared. There can be no place for it in any system of planned production . Special consideration was given in the past to Khandsari on the ground of its being a useful cottage industry. It is not a strong argument, however, as every grower has the easy alternative of converting his sugarcane into Gur. It is not desirable, therefore, to adopt any special measures to keep it alive. The excise duty on Khandsari is at present -/8/- annas per cwt. as against Rs. 3/- per cwt. on sugar produced by vacuum pan factories. It would be desirable to increase it to the latter level as soon as vacuum pan factories are in a position to meet the demand of the country. The production will, however, even under the present conditions (provided price control is effective) continue to decrease and will by 1950 we believe not exceed say 50,000 tons.

13. Expansion of existing units.—Thus with the equipment now available and the improvements that can legitimately be expected, the annual production of sugar in India will, in 1950, amount to 13,00,000 tons. This leaves a gap of 3,00,000 tons. It is desirable, in the first instance, to improve efficiency and lower costs by the extension of uneconomical units. Factories with a crushing capacity of more than 250 tons and less than 800 tons daily should be encouraged to expand to the latter capacity, if there are reasonable prospects of the xtra cane being found within an economic distance. Also all factories should be allowed to improve their efficiency by installing up to two sets of cane knives and up to 17 rollers, and enlarging their boiling house capacity to cope with the resultant increase in the crushing capacity. We are not recommending general extension to more than 800 tons capacity as that would serve to accentuate the already existing concentration of production in U. P. and Bihar, and we are similarly not recommending the extension of factories of less than 250 tons capacity as in their case the change would be not an extension but a complete substitution. If all factories make these changes, their production capacity will increase by 2,00,000 tons. It is likely, however, that many of them will, owing to the limitations of cane supplies or financial and other difficulties, be unable to expand. The annual increase in production on this account may be estimated at about, 1,00,000 tons.

14. Installation of new units.—It is, therefore, necessary to instal new units with an annual production capacity of 2,00,000 tons. We

recommend that twenty new units with a daily crushing capacity of 800 to 1000 tons or an annual production capacity of 10,000 to 12,000 tons be installed as early as possible. The cost of producing sugar in units of a smaller size is likely to be too high to bear competitive conditions.

15. The improvements expected and the extensions contemplated above will give the industry, under average conditions, a normal production capacity of 16,00,000 tons, but its potential capacity will be higher and it will easily be able to produce an extra. 1,50,000 to 2,00,000 tons if necessary to cope with a bumper cane crop. On the other hand production may be lower if the crop is poor in any year and sufficient sugarcane is not available to factories.

16. **The present concentration of sugar industry in U. P. & Bihar.** —A feature of the sugar industry is its concentration in the U. P. and Bihar. These provinces together have 103 of the 154 vacuum-pan factories in the country and normally account for 70 per cent. of the production. The following comparative figures regarding the area under sugar, the number of factories, and the production of sugar, in India and in certain provinces in 1931-32 and 1943-44 is of interest in this connection :—

	Area under cane (thousand acres)		Number of factories.		Sugar produced.	
	1931-32.	1943-44.	1931-32.	1943-44.	1931-32.	1943-44.
					(Tons)	(Tons)
United Provinces (including Rampur.)	1,593	2,192	14	70	73,000	727,100
Bihar & Orissa ...	282	456	12	33	63,000	212,400
Punjab	475	553	2	2		11,200
Bengal	233	339	—	8		15,600
Madras	117	148	2	12		39,200
Bombay	99	169	2	10	17,000	81,200
N. W. F. P.	44	90	—	1		6,200
Rest of India	—	—	—	18		
TOTAL ...	2,972	4,278	32	154	1,58,000	12,16,000

It has often been emphasised that sugarcane is a tropical plant and U. P. and Bihar being entirely in the sub-tropical region are not suited either for the production of sugarcane or the development of the sugar industry. The figures above however indicate that the concentration of the industry in this region is not purely fortuitous but is due to the recognition by both cultivators and manufacturers that the Gangetic Valley is a suitable area for this crop and this industry. The climate of peninsular India may be more suitable for sugarcane but the cost of production has usually been high, adequate irrigation facilities have not always been readily available to render possible the concentration of sugarcane area in suitable blocks sufficient to feed large factories and competition from other cash crops like groundnuts and tobacco has been severe. What is however surprising is the comparatively low recovery of factories in tropical India, except in Bombay and Deccan States.

The following figures are interesting :

	Recovery percentage. 1943-44	1944-45
United Provinces	9.92	10·12
Bihar	10.53	10.7
Madras	9.31	9.15
Bombay	11,31	11.08
Hyderabad	9.88	9·0
Mysore	10.38	9.81

17. Need for Dispersal.—It is probable that on economic grounds alone there is room for further expansion of the industry in the sub-montane tracts of U. P. and Bihar but it is desirable that major industries should, as far as circumstances permit; be evenly distributed over the country and, therefore, we recommend that all new units should be installed in areas other than U. P. and Bihar. We understand that the Government of India has already given its approval to five new projects, one each in Travancore, Hyderabad, Baroda, N.W.F.P. and Bihar. The first four of them are in areas deficit in sugar.

18. Selection of New Sites.—Sites, therefore, remain to be chosen for only 15 new units. We consider below the claims of individual areas for a share in them :

(1) *Madras* is climaticaly suitable for sugarcane cultivation, but the area under the crop is, at present too dispersed to provide many sites for new factories of the recommended size. There are at present twelve factories producing sugar directly from cane. Of these all but three have a crushing capacity of 300 tons or less. The primary effort should therefore, be to develop sugarcane in their areas to enable some of them to expand their capacity to 800 tons. For this reason only three new units should be allotted to this province.

(2) *Mysore.*—The one factory in this state has not been doing well recently. It produced 30,600 tons in 1939-40 and over 27,000 tons in each of the years 1940-41 and 1941-42. There has been since then a serious deterioration in its position, as the following figures would show :—

	Production in tons.	
1942-43	16,200	
1943-44	20,200	
1944-45	17,500	
1945-46	12,000	(Estimated).

There are however other suitable sites in this State and it is recommended that if the project already approved for Baroda does not materialise, that unit may be allotted to Mysore. It should be mentioned that Mysore is even at present, a surplus area in respect of sugar.

(3) *Bombay and Deccan States.*—There is no site in this area where sugarcane may be readily available for a new factory. There are however possibilities of development if adequate irrigation is made available.

The Provincial Government is at present owing to shortage of food-grains, restricting supply of water for irrigating sugarcane. A change in policy may however come about as soon as normal conditions return. Three new units may, therefore, be allotted to this area, one of which may be reserved for the Deccan States Group (including Kolhapur).

(4) *Punjab & Punjab States.*—Next to U. P. this is the second most important sugarcane area in India, but sugar factories situated there have not had a happy record. There were three factories in the Punjab in 1936. One of them has since shifted to the U. P. Another did not work in the last two seasons. There are two factories in the Kapurthala State, one of which has worked at a loss during the last three seasons. The probability, therefore, is that the Punjab is not a suitable area for sugar production—the recovery has been uniformly low ; but there is some difference of opinion on this and we would provisionally allot three new units to this area, one being reserved for the Punjab States.

(5) *Assam.*—Conditions in this Province are favourable for a limited development of sugar industry, and we recommend the allotment of one new unit to it.

(6) *Bengal.*—We have considered the case of Bengal. There is scope for further development of the industry in this province in the long run, but the immediate problem is to create conditions, particularly in respect of cane supplies, that would enable the existing factories to produce to capacity. Bengal has nine sugar factories with a production capacity of 65,000 tons. They produced a maximum of 55,000 tons in 1940-41. Since then there has been a steady fall in their production and in 1944-45 they produced only 12,000 tons. It will, therefore, be unwise to allot any considerable capacity to Bengal until the production of the existing units is stabilised at a reasonable level, but we would provisionally allot three factories with 30,000 tons production capacity to Bengal on condition that the next two years indicate that the necessary steps to improve cane cultivation have been taken.

(7) *Orissa and Sind.*—Of the two remaining sugar factories it is proposed that one should be allotted to Orissa and one to Sind. With the improvement in irrigation facilities there is prospect of suitable cane areas being developed in these provinces, so as to justify the location of one sugar factory in each.

(8) *Other Areas.*—There are no suitable sites in oher areas where sufficient sugarcane may be available in the immediate future for new sugar factories of the requisite size, except perhaps in the Indore State. This State has however already a sugar factory at a place where sufficient sugarcane is not available and it should be shifted to a better site.

19. Approval of new sites.—The choice of actual sites should be left to the local Governments concerned, but it would be useful to make the Central Government's approval obligatory. That Government would on account of its contact with conditions all over the country, be in a position to judge the comparative worth of each project.

20. Approval of the size and specification of new plants.—It is desirable that the Government of India should approve the size and the specifications of all new plants to be installed in the future and of extensions to existing plants in order to ensure that they are designed to secure maximum efficiency and to yield satisfactory results under competitive conditions. In operating the control over specifications great care will be necessary to see that there is no hampering of initiative—the sole aim should be to safeguard against unbalanced plants.

21. Time limit within which preliminary arrangements for new plants and for extensions must be completed : Re-allocation of factories not put up in time.—As the need for expanding production is immediate the promoters of new projects should be allowed a period of not more than eighteen months within which to make all preliminary arrangements, financial and otherwise and to place final orders for machinery. If the provinces to whom additional units are allotted ,are not able to make these arrangements within two years, the lapsed capacity should be re-allocated as follows :

The first unit should go to Bombay ; the second unit should go to Gwalior, where it is understood a factory-building has already been erected ; thereafter factories not put up in the areas to which they have been allotted should be allocated to U. P. and Bihar, where the prospects of quick development are the most promising. In making allocations to these provinces first preference should be given to Gur Refineries provided they set up cane crushing plants in suitable sites. Similarly if the estimated increase of production by one lakh tons by way of the extensions mentioned in para 13 does not come about, we shall be leaving the country's productive capacity short while waiting for extensions, and therefore a time limit is necessary in this case also. We suggest, in view of the present difficulty of finding machinery, a time limit of thirty months, when the position should be re-examined with a view to see whether any shortage in the estimated increase of production by way of extensions should be made up by fresh allocations for new plants.

22. Shifting of Sugar Factories.—It may be necessary in certain cases, when factories cannot get sufficient cane to meet their daily requirements or cannot run for an average number of days for want of cane, to split and shift part of factory to some other area. This will be permissible provided the aggregate crushing capacity of these split up units does not exceed the capacity of the original plant.

23. Need for State Control.—It is not necessary or desirable to place the industry under state ownership or management. Necessary private capital has readily been available in the past and will be so available for its extension in the future. A certain measure of state control over the production, prices and distribution of sugar is however necessary. Most important sugar producing countries, at some stage or other found it necessary to introduce central control over the sugar industry, primarily to deal with periodical overproduction and to stabilise the prices of sugar and sugarcane. The need for such central control is, in India, at least as much as anywhere else. The industry here has, even in its short career, suffered considerably from wide fluctuations from year to year in the area under sugarcane and the prices of sugar and sugarcane. When there is an abundance of sugarcane, prices are low and its disposal becomes difficult. This results in a reduction in the area under the crop, shortage of cane supplies in the following year and high prices of sugarcane which again, in due course, result in an increase in the area to a high level. Both the cane-growers and sugar factories suffer from this cycle. The former lose in years of low prices what they gain in others. They also suffer, in years of abundant supply considerable inconvenience in the disposal of their produce. The latter are always uncertain of their possible production in any season and of getting a price for their sugar commensurate with its cost to them. On occasions, they were placed in a very awkward position owing to an unexpected surplus resulting in a sudden fall in the price. A serious aspect of such a situation is the feeling of nervousness amongst banks regarding the

safety of their advances to sugar factories, and the demands for their recovery have a further depressing effect on prices.

24. The need for planning production of sugar and sugarcane and stabilising the prices thereof is, therefore, urgent. An important factor, in this connection is the difficulty in estimating the yield of sugarcane, till late in the season, and this occasionally results in unexpected surpluses, or deficits. Under planned distribution it should be possible to build reserves in surplus years and spread their disposal over lean years. Production could deliberately be curtailed for a time to cope with any unduly large accumulation of surplus stocks or these could be exported to neighbouring countries.

25. Regulation of industry in U. P. and Bihar.—There has already been an attempt to control the production and prices in respect of sugar factories in U. P. and Bihar. In 1934 the Central Government passed a Sugarcane Act empowering Provincial Governments to fix a fair price for sugarcane. The only Governments which before the war fixed such a price, from time to time, were those of U. P. and Bihar. The United Provinces and Bihar Governments went one step further in 1938 and assumed more effective control over the industry through their Sugar Factories (Control) Acts. These included the following provisions :—

(1) the establishment of a Sugar Control Board ;

(2) prohibition of the erection of new sugar factories or the extension of the existing ones without a license ;

(3) reservation of cane areas for factories ;

(4) fixation of cane prices ; and

(5) imposition of a cess on sugarcane.

The provisions of licensing included compulsory enrolment in the Indian Sugar Syndicate which was thus recognized by the United Provinces and Bihar Governments as the sole organisation for the selling of sugar produced in the two provinces. The license also included a clause providing for a minimum wage for labour and fixed the quantity of sugar that should be manufactured by it during the period of the license which covered one crushing season. Important amendments were made by the 1940 Amending Act, which constituted a Sugar Commission to be the final authority subject to Government Control, on all matters connected with the production, sale and prices of sugar. It also provided for the linking of the cane and sugar prices by providing for a deferred price for cane when the sugar price rose above the basic level. Another important amendment was made in 1943 prohibiting the cultivation of unsuitable varieties of sugarcane. The Indian Sugar Syndicate, mentioned above was formed in 1936-37 when sugar prices began to fall rapidly below the economic level and it helped to stabilise them. Most of the factories outside U. P. and Bihar did not join it, and soon after even its few members from other areas left it. Initially the Syndicate had a free hand in the marketing of sugar and the fixation of sugar prices. In 1940, however, when a serious crisis arose, owing to the difficulty in the disposal of sugar produced by U. P. and Bihar factories particularly at prices justified by the cost of production, the two Provincial Governments had to extend control over the internal working of the Syndicate. It was thenceforth permitted to make sales only within the limits of prices and quotas fixed by the Provincial Government. With the advent, however, in 1942 of Central Sugar Control, a war-time measure, the Sugar Controller for India took over all function in respect of the prices and distribution of sugar.

26. Control to be exercised by Central Government.—The experience in this country and elsewhere, the desirability of protecting the interests of consumers and harmonising them with those of cane growers and sugar factories, and the need for a machinery capable of prompt action in emergency render it necessary that there should be Central Government Control over all important matters relating to the industry, though the actual marketing may be left to an organisation of the industry itself, within the limits of Government instructions.

27. Matters to be subjected to Central Control.—The following matters should be subject to Central Government Control :—

(1) Location both of new factories and of existing factories when shifted to new sites.

(2) Sizes and specification of plants and additions to and alterations in existing units with the object of ensuring that the crushing capacity does not exceed the capacity sanctioned.

(3) Prices of sugarcane and sugar. A measure of Central Control on sugarcane prices is necessary as sugar prices depend mainly on them.

(4) Production of sugar, including allotment of production quotas to various regions and individual factories.

(5) Distribution of sugar. This will include allocation of sales quotas to individual producing areas and factories and also allocation of supplies from individual factories to various regions, with a view to avoid cross haulage and minimise the cost to consumers. In doing this the normal markets in pre-war days of factories should be taken into consideration.

(6) Fixation of carryover each year and its distribution amongst factories.

(7) Conditions of labour. This is necessary not only as the cost of labour is an important factor in the cost of production of sugar but also in conformity with the general national policy of giving a fair deal to labour.

(8) Exports including control over policy, quality, packing and prices.

(9) Production, quality and prices of special sugars and confectionery.

28. Need for collaboration with Local Governments.—The Central Government should exercise such control in close collaboration with local Governments and should, in particular, give them within the general frame-work of all-India policy, a free hand in respect of the location of factories, additions to and alterations in them, intra-provincial distribution of sugar, steps to discourage cultivation of undesirable varieties of cane and conditions of labour. Formal Central control over these matters is desirable only to ensure a general uniformity of policy throughout the country, and to obviate the possibility of any action by local Governments that might place the industry in any particular area or a section of it in a position in which it might become difficult for it to stand competitive conditions. If the cost of production of any group of factories is particularly high, pressure might be brought on the Central Government to fix the price of sugar at a level necessary to accommodate them. Such a contingency should be avoided in the interests of the efficiency of the industry in general and those of the consumers in particular.

29. **Existing local legislation to be abrogated.**—All provincial legislation dealing with matters proposed to be brought under Central control will have to be abrogated and replaced by a Central Statute. Provinces will obtain delegated powers in respect of functions entrusted to them. All local cesses on cane should be abolished if they are incompatible with the all-India Control and Policy.

30. **Executive authority.**—The executive powers as regards Central control should be vested in an official Controller. He should have a representative Central Board to advise and assist him on matters of policy and a small technical committee to advise on problems relating to the extension of factories, replacement of machinery and generally on matters affecting the technical efficiency of the industry. The Central Advisory Board should consist of not more than seven representatives of the Governments of various regions, seven representatives of the industry, two of consumers, four of cane-growers, and two of labour. If at any time the Controller decided to trurn down the advice of this Board he should state his reasons in writing. The Board should have the right of appeal to the Government of India against his decisions.

31. **Marketing Organisation.**—The actual distribution of sugar should be by an organisation, the membership of which should be compulsory for all sugar factories.

32. **Levy of a charge to cover obligations in respect of exports and storage.** This marketing organisation or the Controller should levy a charge of one or two annas per maund for meeting any financial obligation in respect of exports and to compensate individual factories, if necessary for storing sugar surplus to the requirements of any particular year.

33. **Need for Indian states having a common policy.**—It is desirable that the policy of the producing Indian States in respects of the production, prices and distribution of sugar be brought into the line with the all-India policy in the matter and that they should participate in the operation of all-India Control on the same basis as British Indian provinces. We appreciate the constitutional difficulties involved but wish to express the hope that a reasonable solution of them would be found to ensure smooth working of sugar and other industries.

34. **Protection to continue.**—As there is little likelihood of the Indian Industry being able to compete with Java in the internal market during the next five years, it would be necessary to continue tariff protection to it during this period. The quantum of protection required will, however, depend on the comparative costs of production in the two countries when normal conditions return. It is yet too early to make any reliable estimates in this regard and the matter will, in due course, have to be considered by the Tariff Board. Meanwhile the existing duty should be extended.

35. **Maintenance of Excise duty.**—The quantum of the Excise Duty is directly related to the import duty. The existing import duty is at a level which enabled the local industry to compete with Java after the payment of Excise. It will be able to bear any Excise Duty as long as this relation between it and the import duty is maintained. The imposition of the excise duty, however, increases the cost of sugar to the consumer, which in a poor country like India results in curtailment of consumption. It is recommended accordingly that both the excise duty and the protective duty should be gradually reduced.

36. **Reduction in the price of sugar desirable : measures required.**—Efforts should be made steadily to reduce the cost of sugar. This is

only sure way to lead to a greater consumption of sugar in the country. This could be achieved by—

(a) lower cost of growing cane ;

(b) higher recovery from cane ;

(c) lower excise duty ;

(d) improved efficiency ; and

(e) limiting of profit.

(a) and (b) are being considered by the Central Sugarcane Committee. From the excise duties levied on sugar, funds on a much bigger scale should be placed at the disposal of the Sugarcane Committee for studying these problems and taking steps towards the lowering of the cost of growing cane and increasing recovery. The Panel considers that in both these matters there is room for considerable improvement. Regarding the raising of the efficiency of the sugar factories, boiler furnace designs and consumption of steam in factories should be definitely improved so that the fuel consumption could be reduced appreciably. There is considerable scope for improvement both in the chemical and engineering sections of the sugar factories. Competent chemists and engineers should regularly inspect each factory, thoroughly examine its workings and advise on the ways and means by which economy could be effected. Individual factories may not, however, be able to afford sufficiently Competent help and this may not, always be available to them locally. It is recommended that the supervising and inspecting Chemists and engineers should be attached to a Central Organisation such as the Imperial Institute of Sugar Technology. The total revenue from sugar excise duty is likely to be increased on account of the increased consumption of white sugar as recommended by the Panel. The Panel suggests that a downward spiral of lowering prices should be created by the lowering of the excise duty by the Government. Sugar prices should be so fixed that the margin of profit should be reasonably low. The sugar industry is no longer a pioneering industry and the elements of uncertainty and risk are not great now. Hence a lower margin of profit is justifiable. Also, with higher outturn it should be possible to reduce the margin between the production and selling prices of sugar.

37. **Need for intensification of agricultural and technological research.**—The industry does not need any bounties as it is receiving and will presumably continue to receive the necessary protection through the tariff policy. It does not require any special expert advice from abroad, except for fabrication of machinery. A competent advisory service should, however, be organised to inspect factories and to help them in improving their technical efficiency, whether by remodelling of their machinery or by improving manufacturing processes. The existing Institute of Sugar Technology is not sufficiently well-equipped for the purpose and its staff and equipment should be augmented to meet the requirements of the industry. Research both agricultural and technological should be intensified, with particular reference to the varying conditions in the different parts of the country. The Central Government, at present, gives a grant of -/1/- anna per cwt. from the Excise Duty to the Indian Sugar-cane Committee for the purpose. This is inadequate and should be increased to -/4/- annas per cwt.

38. **Utilisation of by-products.**—The production of power alcohol and food yeast from molasses, which is the most important by-product of the sugar industry, will be discussed later. Steps should also be taken by the organisation of research and application to make proper use of

press mud and bagasse. Bagasse is at present mainly burnt as a fuel in the sugar factories. Many factories consume coal or wood fuel, in addition to bagasse. With improvement in technical efficiency it should be possible for factories not only to dispense with all extra fuels but also to save bagasse for other purposes. Bagasse has been found useful for the manufacture of insulating and pressboard, wrapping paper and straw-board. It has been used for the manufacture of plastics and resins. Glass, suitable for making coloured bottles, has also been prepared from baggasse ash. Press mud could be used or the preparation of fertiliser, wax, activated carbon, dye-stuff and distemper. The above uses for bagasse and press mud require further investigation.

39. **Comparative duty on finished Machinery & Raw Materials for Manufacture of Machines.**—The Panel is of opinion that the duty on component parts or raw materials from which machinery is made should in no circumstances be higher than duty on finished machinery.

40. **Need for intensifying cane development with particular reference to certain aspects.**—The greatest scope for improvement in the efficiency of the industry, with a view to reduce the cost of production of sugar, is by improving the quality and yields of sugarcane. The cost of sugarcane is the most important item in the cost of sugar. Therefore, while it is recognised that various other considerations might contribute to the statutory determination of the price at which cane may be sold to factories, it is essential that it should be produced cheaper than at present and should yield a higher recovery of sugar. Considerable work has, in this regard, been done, during the last ten years, by the Central and Provincial research stations and the local departments responsible for the development of sugarcane in the field. Reliable statistics regarding improvement in the yields of sugarcane are not available, but there is no doubt that these have in recent years increased, particularly in the factory areas in U. P. and Bihar. Improvement in recovery is more clearly noticeable as the following figures show :—

Year.	Recovery percentage.		
	U. P.	Bihar.	India.
1931-32	8.59	9.06	8.89
1944-45	10.19	10.69	10.2

Nevertheless the success achieved has been much below expectations. There is considerable scope everywhere, and particularly in areas like Bengal, further to improve the yields and quality of sugarcane, and it is an urgent necessity that the Central Government, through the Indian Sugarcane Committee and the Local Governments in collaboration with it and through their departments of agriculture and cane development, should force the peace of improvement by all possible means, special stress being laid on the specific problems of indvidual areas. Steps should concurrently be taken to augment supplies of sugarcane at factory gates, by improving means of communication, and to regulate supplies in a manner that would ensure the maximum actual recovery of sucrose available in cane. The following items should have a special place in development programmes :—

(1) Propagation and introduction of new varieties giving higher yields per acre and a better recovery of sugar, with particular stress on early and late ripening varieties. Conditions in each producing area should be separately studied with a view to evolve varieties suitable for them.

(2) The practice of ratooning should be more carefully examined so that cane-growers and factories should be able to secure maximum results in yield and recovery.

(3) Research should be made to improve the existing manurial practices and arrangements should be made for the adequate supply of fertilisers.

(4) Provision of adequate irrigation facilities and improvement in irrigation practices.

(5) Research with a view to devise improved agricultural implements to suit local conditions.

(6) General improvement in methods of cultivation, including rotational practices.

(7) Devising practical methods of controlling insect pests and diseases.

(8) Provision of an adequate field organisation in every producing area to give general guidance to growers in matters relating to cane cultivation, to enable the quick application by cultivators of the results of research, to ensure timely control over insect pests and diseases, and to arrange for the adequate and timely supply of seed, implements and fertilisers. A chain of suitably located model farms run by the Government, sugar factories or co-operative societies, as may suit local conditions, should form an integral part of the scheme.

(9) Improvement of communication in factory areas by construction of a net-work of roads and assistance to factories in putting up tramways and obtaining diesel lorries, preferably with trailers.

(10) Regulation of sugarcane supplies to factories in a manner that would ensure supply to them, throughout the crushing season, of fresh and properly matured cane.

41. Increase in yields & recovery expected.—It should, by action on the lines indicated above, be possible to increase the yield of sugarcane generally by at least 25 per cent. in the next five years and the recovery of sugar from sugarcane by one per cent.

42. Confectionery and special sugars.—The manufacture of confectionery of good quality and special sugars such as sugar cubes, Demerara sugar, Icing sugar and fruit products like jams and squashes should be encouraged. The Tariff Policy in respect of manufactured goods of which sugar is an important ingredient should be revised by increasing the import duty on them to a level that would place the sugar imported in indirect forms at par with ordinary imported sugar.

43. Requirements of capital goods.—The expansion of the Sugar Industry required for reaching the target production of 16,00,000 tons of sugar annually may be secured by (1) fuller exploitation of the existing capacities of sugar factories, (2) enlargement of existing small plants to a capacity of about 800 tons cane per day and (3) construction of about 20 new factories of 1,000 tons cane per day capacity. For securing such expansion, a fairly large quantity of sugar machinery will be

needed. The proposed 20 new factories will require approximately 40,000 tons of machinery valued roughly at £4 millions or 5.3 crores of rupees F.O.B. port of shipment. Almost an equal quantity of machinery will be needed for the proposed extensions to existing factories. A large amount of machinery and machinery parts will also be required for effecting renewals and replacements in existing factories, which have fallen heavily in arrears during the recent war years.

The total cost of all the machinery required for the purposes stated above, including insurance, import duty and sea freight to Indian ports, is therefore, likely to be about £9 millions or 11 to 12 crores of rupees. Detailed lists of machinery required have been drawn by the Imperial Institute of Sugar Technology (see Appendix XIV) and the estimated cost has been based on the average present prices in important sugar machinery manufacturing countries abroad.

At the same time detailed enquiries have been made by the Institute to ascertain the possibilities for the fabrication of sugar machinery by engineering firms in India. It has been found that there are several such firms possessing equipment suitable for this type of work who would presumably gladly take it up now that the pressure of work in connection with the war is reduced. The items of machinery likely to present some difficulty, at least in the initial stages, are electrical goods, engines, boilers and some of the material required for the fabrication of this machinery, such as special steels, brass and copper tubes, Calandria plates, copper liners, etc., which are not made in India yet.

In the opinion of the Panel, there is little doubt that a substantial if not the greater, part of the machinery required for sugar manufacture can be made within India.

There are *prima facie* grounds for holding that the cost of manufacturing sugar machinery in India will be lower than that of importing such machinery from abroad; at any rate, this is likely to be the position at least during the next few years, in the course of which it is unlikely that the high level of prices now demanded by foreign manufacturers of machinery will come down. But even if, contrary to present expectations the cost of making sugar machinery in India should turn out to be somewhat higher than the cost of importing such machinery, there will still, in the opinion of the Panel, be sufficient compensatory advantages in manufacturing the machinery in this counrty, which will more than offset the higher prices, assuming that the prices will be higher. For one thing, and quite apart from the obvious advantage to the engineering industry of the country, it is clear that the setting up of an industry for the manufacture of sugar machinery will facilitate replacements and repairs of such machinery and reduce the cost thereof in the long run. For another, in view of the urgent need for increasing the production of sugar and the uncertainty in respect of deliveries of machinery from abroad in the next few years, it would appear that India should rely, as far as possible, on manufacturing its own machinery. The Panel accordingly recommends that a central expert organisation attached possibly to the office of Sugar Controller or the Imperial Institute of Sugar Technology, Cawnpore, should be set up for ascertaining requirements, for classifying and consolidating them, for the programming of their supply, for the preparation and supply of design, and for organising contacts between factory owners and engineering workshops. When this organization has been set up, priority and other assistance for the import of sugar machinrey should be given only in respect of establishment of plants such as power plants, power units, etc., which cannot be manufactured in India without difficulty.

POWER ALCOHOL.*

44. It is desirable to develop the power alcohol industry in India with the objects primarily :

(a) of establishing an alternative source of motor fuel partially to replace petrol, the indigenous supply of which in the country is short, and

(b) of utilising the surplus of molasses which is wasted at present.

45. In all progressive countries, where indigenous petrol is not available in sufficient quantities, it has been considered desirable to develop alcohol as a motor fuel. Great Britain, France, Germany, Poland, Czechoslovakia, Italy, Australia have all been producing power alcohol from indigenous sources such as beet, potatoes and corn ; and, to a certain extent, from imported molasses. The cost of alcohol in most of these countries is much greater than that of imported petrol. The production and use of alcohol as a motor fuel has, nevertheless, been encouraged and State aid given generously by means of rebates, bounties and by special regulations.

46. Of all raw materials from which alcohol can be produced on a large scale, molasses is known to be the most suitable. Brazil, which grows sugarcane in abundance, and produces a large quantity of molasses as a by-product in the sugar factories, has developed a flourishing alcohol industry. The production of alcohol has increased steadily in recent years and in 1941-42, which is the latest year for which figures are available, nearly 29 million gallons of alcohol were produced in Brazil. Of this quantity about 19 million gallons were obtained from molasses, 8 million gallons from cane juice and 2 million gallons from re-dissolved sugar.

47. Although India is now one of the biggest sugar producing countries in the world, no systematic attempt has so far been made here to develop the power alcohol industry. At present, there are only five distilleries in India capable of producing power alcohol. Of these, two are in the United Provinces, one each in Bombay Province, Hyderabad and Mysore. The combined maximum capacity of the three distilleries in British India is about one and a half million gallons, annually. The two distilleries in Hyderabad and Mysore are capable of producing about 500,000 gallons each per annum. When they are in full operation, the five distilleries are thus capable of manufacturing about two and a half million gallons of power alcohol. Their total production, so far has not, however, exceeded one million gallons a year.

48. Nearly 400,000 tons of molasses are produced annually in India as a by-product of the sugar industry. About 150,000 tons of molasses are utilised ordinarily for the manufacture of rectified spirit, potable alcohol, methylated spirit and the curing of tobacco etc. Approximately 250,000 tons of molasses are thus left over annually, for which no satisfactory use has been found. Part of this is burnt as fuel ; a small portion used as manure in the field ; and the greater portion is thrown away as waste, fouling the water-courses and the countryside.

49. The estimated pre-war consumption of petrol in India is 100 million gallons. Of this only about 17 million gallons were produced

* The term " power alcohol " as used in this report denotes anhydrous alcohol of at least 99.5 % strength by volume. The term "rectified sprit" is used to denote alcohol of 94.0% strength by volume and above (Grade I strength 96 % alcohol and over ; Grade II strength 94%—96% alcohol).

in the country ; the rest was imported, about 74 million gallons from Burma and about 10 million gallons from other countries. Thus India has been dependent on other countries for over 80% of her requirements of petrol. The production of power alcohol would increase our resources of motor fuel and would be important for strategic reasons or on occasions of exchange difficulty such as at present.

50. At the present moment on account of the scarcity of motor fuel, a number of motor vehicles have been fitted with producer gas plants. The use of producer gas has not been an unqualified success in this country and it is believed that in future not many motor vehicles would continue to run on producer gas. Also, it is believed that motor vehicles run on diesel oil will not be so numerous as to effect appreciably the consumption of petrol. With the increase of inter-provincial trade and the construction of new roads the demand for low flash point liquid motor fuel is expected to increase appreciably and it is estimated that in the very near future this requirement would reach 120 million gallons per year.

51. The Panel has recommended that the production of sugar in the country should be increased to 16,00,000 tons per year within the next five years. The surplus molasses available from this quantity of sugar will be adequate for the manufacture of 20 million gallons of power alcohol per annum which should be taken as our target of production to be reached within the next five years.

52. Manufacture of power alcohol recommended by Government Committees, chambers of commerce and bodies representative of the sugar industry.—The problem of the manufacture of power alcohol has been examined several times in recent years by various Committees appointed by Government. In 1938 the Indian Tariff Board of Sugar Industry examined the question of utilisation of surplus molasses and the production of power alcohol. The Board definitely recommended the starting of power alcohol production on an all-India basis and commented very favourably on the prospects of the venture. The report stated that "the industry and the Provincial Governments are united in the view that the manufacture of power alcohol is from the economic point of view the only profitable outlet for molasses in present conditions"; and also that "the establishment of so important a by-industry can be commended as a step in the direction of India's industrialisation and as an outlet for Indian capital and the means of remedying the unemployment problem".

53. A Joint Power Alcohol and Molasses Inquiry Committee consisting of well-known scientists and industrialists was appointed by the Governments of the United Provinces and Bihar in 1938. After a detailed and careful examination of the question, the Committee observed that the conditions in the United Provinces and Bihar (with which it was specially concerned) were very favourable for the manufacture of power alcohol.

54. More recently, at a conference convened by the Deptt. of Planning and Development in November 1944, the question of the establishment of the power alcohol industry in India was discussed by the representatives of the Central and the Provincial Governments, and the Indian States. The views expressed at the Conference were definitely in favour of large-scale production of power alcohol.

55. The Chambers of Commerce in the country and the Bodies representing the Sugar Industry have supported proposals for the establishment of power alcohol industry and on several occasions have expressed their disappointment that the proposal has not been implemented more fully and with greater vigour.

56. Most suitable mixture of alcohol and petrol for use as standard motor fuel.—While in certain parts of the country, where large distilleries for the manufacture of rectified spirit are already in existence, unmixed rectified spirit could be used with advantage for stationary engines, agricultural tractors and certain commercial motor vehicles, it seems desirable that a uniform mixture of power alcohol and petrol should be adopted throughout the country as a standard fuel for internal combustion engines. The Panel considers that a mixture of 20% power alcohol and 80% petrol is the most suitable for this purpose. (For a discussion of the technical aspects of the use of alcohol as a motor fuel see Appendix XXI). The mixture is in many respects superior in performance to neat petrol. It has an octane value higher than that of petrol and consequently better anti-knock properties ; it is more volatile and the engine can be started in the cold more easily ; it has a higher latent heat and can bear higher compression ; the power output of the mixture is for all practical purposes the same as that of petrol ; it deposits less carbon in the combustion chamber of the engine ; and it does not have any more corrosive effect than straight petrol.

57. The mixture of 20 per cent alcohol and 80 per cent petrol could be used in motor vehicles inter-changeably with petrol without any alteration in the carburettor and engine settings. This is an important point in the early stages of the development of the power alcohol industry, as power alcohol for admixture with petrol may not be available everywhere, and a motorist moving from one district to the other may be required to use either the mixture or ordinary petrol, according to what is available. The percentage of power alcohol in the mixture with petrol could be made to vary from 20% down to nil without appreciably changing the properties of the fuel. This permits of considerable flexibility in planning the distribution, particularly in the early stages, when power alcohol may not be available everywhere in required quantities . Alcohol is absolutely essential for certain industries, while it is not absolutely essential for motor transport that alcohol should be mixed with straight petrol in any definite proportion. The off-take of power alcohol for transport purposes can therefore be adjusted to suit the quantity of power alcohol available for this purpose.

58. Cost of power alcohol.—The joint Power Alcohol and Molasses Inquiry Committee of United Provinces and Bihar (1938) carefully examined the question of the cost of production of alcohol. According to their findings, power alcohol could be produced at a cost of 6 to 7 annas per gallon. More recent estimates are also available. According to an estimate prepared by the Aluminium Plant & Vessel Col., Ltd., the cost of production works out as follows :—

(See Appendix XVI).

TABLE I.

Price of molasses at 4 annas per maund.

Average number of working days 300 per annum.

Cost of production of power alcohol in plant producing 2,200 gallons per day or 660,000 gallons per annum.	7.4 annas per gallons.
Cost of production of power alcohol in plant producing 4,400 gallons per day or 1,320,000 gallons per annum.	5.9 annas per gallon.
Cost of production of power alcohol in plant producing 6,600 gallons per day or 1,980,000 gallons per annum.	5.2 annas per gallon.

These figures are based on the cost of materials as in September 1942.

59. Details of the cost of erection of a distillery of production capacity 3,300 gallons power alcohol per day, based on the present cost of materials has been worked out by a Sub-committee of the Panel and is shown in Appendix XVII. As the prices of most of the materials required for construction are controlled, the cost of erection of aplant in 1945-46 will not be appreciably different from that in September 1942. Making allowance for the present enhanced prices of fuel, chemicals, etc., we arrive at the following revised estimate of the cost of production of power alcohol :—

TABLE II.

In a 2200 gallon/day plant	...	... 8.0 annas per gallon.
In a 3300 gallon/day plant	...	... 7.2 annas per gallon.
In a 4400 gallon/day plant	...	... 6.5 annas per gallon.
In a 6600 gallon/day plant	...	... 5.8 annas per gallon.

60. If the price of molasses is reckoned at 6 annas a maund instead of 4 annas as in the above estimates the production cost will be as follows :—

In a 2200 gallon/day plant	...	... 8.8 annas per gallon.
In a 3300 gallon/day plant	...	... 8.0 annas per gallon.
In a 4400 gallon/day plant	...	... 7.3 annas per gallon.
In a 6600 gallon/day plant	...	... 6.6 annas per gallon.

61. Comparison of Prices of Power Alcohol and Petrol.—The selling price of Petrol ex-Pump at a port is arrived at by adding to the calculated price of petrol at the port the Government duty of 15 annas per gallon, clearance and storage charges, distributor's charges, the agent's commission, etc. For the selling price ex-pump at up-country places, the cost of transport from the nearest main port is added. It has not been possible to obtain an accurate figure of the cost of production of petrol in this country, or the landed cost of imported petrol. According to the system of calculation adopted by the oil companies, the price of petrol at present may be taken as $6\frac{1}{2}$ annas per gallon at the port of Bombay. The price is about the same at Madras and Karachi. With the return of normal conditions, the price of petrol, however, might become less.

62. The cost of production of power alcohol in standard distilleries of capacity 3300 gallons per day or about one million gallons per year of 300 working days, which is the size recommended by the Panel, will be about 7 to 8 annas per gallon varying with the price of molasses from 4 to 6 annas per maund. The production cost in larger size distilleries,some of which it may be feasible to put in special areas, will be lower.

63. Though it should be our aim to manufacture all power alcohol in modern distilleries of one million gallons/year capacity or above, it may not be feasible to do so in the beginning. The question of the distilleries which have been producing rectified spirit in order to meet the large demand of the Defence Services and other essential requirements will have to be considered carefully. Some of these are so antiquated and badly designed that it will not be economical to refurbish them. In the case of others, however, an attempt should be made to convert them into power alcohol distilleries by the addition of necessary dehydrating columns. The production cost of power alcohol from these distilleries will be comparatively high. The same is to a certain extent true in the case of smaller distilleries of modern designs, some of which it may be necessary to instal in areas where the supply of molasses is not abundant.

64. In the United Provinces and Bihar where molasses is readily available, and where the first new modern distilleries should be located, it may be possible to make power alcohol available at a price lower than petrol, which has to be carried in tank wagons from the main ports. For other areas specially those in and about the port towns, the price of alcohol would be higher. It would, however, be possible to cut down considerably the cost of transnport of power alcohol from the distilleries to the ports by utilising for transport the empty tank wagons returning to the ports after discharge of petrol in up-country areas.

65. On the whole, it seems reasonable to expect that the difference in cost between power alcohol and petrol will not so great as to affect appreciably the price of the alcohol petrol mixture. The mixed fuel will contain only 20% power alcohol, and even in most unfavourable circumstances, when the cost of power alcohol is appreciably higher than that of petrol, the selling price of the mixture to consumers will not be more than 1½ to 2 annas per gallon higher than that of unmixed petrol. To a certain extent the extra cost will be justified as the power alcohol/petrol mixture will be a better motor fuel.

66. It may be stated that hardly anywhere in the world has power alcohol been produced at a price competing with that of petrol.. In European countries in pre-war years, power alcohol was heavily subsidised. A summary of the Report of the Power Alcohol Committee of Inquiry of Australia, 1941, may be seen in Appendix XXII. It will be seen therefrom that although the calculated cost of production of power alcohol was considerably higher than that of petrol, the Committee strongly recommended the production of power alcohol and advocated its use in place of imported petrol. The conditions in India, as in Brazil where a considerable power alcohol industry has been developed in recent years, are much more favourable than in England. Czechoslovakia, Germany or Australia, as a comparatively larger quantity of molasses is available in this country, much of which is wasted at present and can therefore be had at a low price. Although the cost of power alcohol in India might be somewhat higher than that of petrol, the difference is likely to be much less than in Australia or in the European countries mentioned above.

67. Excise duty on Power Alcohol.—The Government of India have so far opposed all proposals for preferential treatment of power alcohol used as motor fuel in respect of exemption from excise duties. As pointed out above, the price of power alcohol might be higher than that of petrol. The consequent increase in the price of alcohol-petrol mixture, as compared with that of unmixed petrol will have to be borne either by the consumers or by the State. The Panel considers that in view of the strategic importance of the development of the power alcohol industry the latter alternative would be more desirable, and therefore recommends that the excise duty on power alcohol should be less than that on petrol.

68. Production of Power Alcohol.—The standard size of distilleries should be one million gallons capacity, but a smaller size of half a million gallons capacity may be allowed in special areas having a smaller output of molasses. Units larger than one million gallons capacity may also be permitted in certain cases.

69. Sugar factories should be divided into groups, each capable of meeting the molasses requirements of one distillery. Each distillery may be owned jointly by factories supplying the molasses, the share of each sugar factory in the distillery being in proportion to its capacity for supplying molasses.

70. While the sugar factories might be given an option to join as shareholders of the distillery, the selling of molasses to the distillery in proportion to the crushing capacities of the factories should be made compulsory. The actual quantity of molasses requisitioned would depend on the size of the distillery.

71. **Licensing of Distilleries.**—It is proposed that all distilleries should be licensed. A definite policy should be laid down for licensing and the following points should be kept in view in sanctioning a license :—

(a) Availability of molasses ;

(b) Cost of transport of molasses from the sugar factories to the distillery ; and

(c) Cost of transport of alcohol from the distillery to mixing depots.

72. Each sugar factory should have covered storage capacity for about 75% of its molasses production and the distilleres should have arrangements for the storage of at least 50% of their annual requirements of molasses.

73. **Location of distilleries.**—A list of the principle distilleries in existence at present is given in Appendix XV. Those are that properly situated in respect of their supply of molasses should be given an opportunity to expand to the prescribed limit. If they are unable to make the necessary extensions, they should be replaced by new units. In the past some distilleries have been wrongly located. The cost of transport of molasses to these will be permanently higher. It may be worthwhile shifting these distilleries to more suitable places and the Government might meet a part of the cost of removal in such cases.

74. The standard distilleries should be situated mostly in the United Provinces and Bihar which are the main sugar producing areas. Suggestions about the proposed locations of 11 distilleries in the U. P., 1 in Bihar, 2 in Bombay, 2 in Madras and Orissa and in Bengal for the production of power alcohol, and about the grouping of sugar factories for supply of molasses to them are indicated in Appendix XIX.

75. **Mixing.**—The mixing of power alcohol with petrol should be compulsory in such proportion as might be prescribed and in such areas as are notified from time to time. The mixing should be done in the petrol storage depots at present run by the different oil companies, the sites of which are shown in Appendix XX.

76. **Areas supplied by power alcohol/petrol mixture.**—In the interest of economy in transportation it is obviously desirable at first to put power alcohol in use in areas around the centres of production. The use of power alcohol/petrol mixture in such areas should be compulsory. In the event of short supply of power alcohol, the area supplied with the alcohol/petrol mixture should be cut down, maintaining the same percentage of alcohol in the mixture. Beginning should be made with the U. P. and Bihar and areas around them where power alcohol would be easily available in required quantities. Other areas should continue to use neat petrol till such time as the mixture becomes available. The total area supplied by the alcohol/petrol mixture should progressively expand with increasing production on alcohol.

77. **Control of power alcohol and molasses : appointment of Alcohol Commissioner.**—Power alcohol should be produced in distilleries owned and managed by Sugar factories, but the control over its production,

distribution and price should be vested with the Central Government. An Alcohol Commissioner should be appointed to exercise this control on behalf of the Central Government.

78. The Alcohol Commissioner will (a) be the licensing authority for all distilleries producing power alcohol ; (b) supervise the industry and ensure that the standards of production are maintained ; (c) deal with disputes and difficulties in connection with the industry ; (d) direct the future development of the industry so as to be in line with the sugar industry ; and (e) fix the price of power alcohol. The Sugar Controller might with advantage be appointed as the Alcohol Commissioner in addition. He should be assisted by a Committee having the same powers as in the case of Sugar.

79. It is essential that there should be strict control by the Central Government over the movement and price of molasses so as to ensure its availability to the distilleries. There should also be adequate safeguards to maintain the quality of molasses. The price of molasses should be based on the total fermentable sugar present expressed as hexose. There should be price deduction or other penalties for dirty molasses or the presence of harmful substances such as SO_2, as these cause considerable difficulties to the distiller.

80. Molasses is required for tobacco curing, potable spirits, and other industrial purposes besides the manufacture of power alcohol. It should be arranged with the sugar factories as to what proportion of their molasses should be sold for purposes other than the manufacture of power alcohol in different regions. This should be limited to 25% of the total production of molasses. The Alcohol Commissioner should be entrusted with the responsibility for control of molasses. Any particular Provincial Government in consultation with the Controller, may make arrangement to modify this limit of 25%.

81. Expert adviser.—The Panel does not consider the appointment of a firm or firms as consultants as necessary, but thinks it to be desirable that an expert should be attached to the Alcohol Commissioner to help and advise the industry on the fabrication of plants and the production of alcohol.

82. Transport of molasses and power alcohol : necessity for the reduction of railway freights.—With the establishment of a number of large distilleries the traffic in alcohol and molasses would increase very considerably and it is necessary that there should be adequate number of railway tank wagons available for their transport. The Panel understands that there will not be much difficulty regarding the availability of tank wagons when the present abnormal demands on the railways cease and new wagons becomes available.

83. As already stated, the production of power alcohol will be confined mostly to the United Provinces and Bihar. Alcohol will therefore have to be transported to the mixing depots in different parts of the country. The Panel feels that in order to reduce the selling price of power alcohol which would make its use feasible, it is essential to keep the freight charges as low as possible. Tank wagons returning empty at present, after conveyance of petrol from ports to the up-country towns, may be used to take back power alcohol to the port towns. The Railways should find it possible to fix lower rates for the conveyance of power alcohol in the tank wagons which would otherwise return empty.

84. In the opinion of the Panel the distilleries proposed to be put up for the production of power alcohol would probably get one-third of their requirements of molasses on the spot and two-thirds from areas

varying from 5 to 40 miles distant. In order that the distilleries may operate as economic units, it is essential that molasses should be available to them at a very cheap price.

The cost of molasses at the distilleries would depend to a great extent on the cost of railway transport from the sugar factories. It is, thus, important that the Railways should charge the lowest rates possible. To enable the Railways to quote lower transport rates for molasses, it is desirable that the tank wagons carrying molases should be kept busy all the year round and should not be required only for a few months in the year. The Panel is also of the opinion that the freight charges for the carriage of molasses from places between 5 to 40 miles should be the same, so that the price paid for molasses at all distilleries may be uniform. The Railway Board has already been requested by the Panel to consider the points mentioned above.

85. Sales organisation for power alcohol.—The distribution and sale of power alcohol should, it is suggested, be carried out for the present by the existing oil companies. In the event of their unwillingness to do so, a new organisation would have to be set up under control of the Central Government.

86. A method of marketing power alcohol on an all-India basis at a uniform price is given below :—

(a) A schedule of prices should be drawn up for molasses depending on its content of fermentable sugar and its purity. Molasses should be purchased by the distiller direct from the sugar factory and the scheduled price paid for it. This price should be for molasses loaded into the tank wagons by the factory.

(b) The distiller should be responsible for unloading the tank wagons.

(c) Power alcohol should similarly be purchasd direct from the distiller (free on transport) by the oil companies who would be responsible for unloading.

(d) The cost of transport (mostly by rail) would be collected direct from the oil companies by the Railways, etc., on the basis of the number of gallons supplied to each company irrespective of the distances involved. This cost is to be worked out on the total transport charges of alcohol.

(e) The cost of transport would be estimated in advance by the Alcohol Commissioner for any convenient period (say quarterly) and the sale price of the mixed product for that period fixed accordingly. Any miscalculation for one period would be corrected by altering the sum to be paid in the next.

(f) The charge per gallon of mixed motor fuel to the public will be made up as follows :—

(i) Cost of oil Co.'s petrol ...	4/5 gallon.
(ii) Cost of power alcohol ...	1/5 „
(iii) Cost of transport of alcohol to the misxing depot	1/5 gallon.
(iv) Cost of transport of petrol to the mixing depot	4(5 „
(v) Oil Co.'s charges for distributing, mixing etc.	per 1 gallon of mixture.
(vi) Central Government Tax ...	per 1 gallon of mixture.

87. At present the tax on the motor spirit is collected from the consumer through the oil companies. The price paid by the consumer at the pump includes this tax, and the oil companies act as tax collectors. In the scheme detailed above the oil companies would also act as freight collectors.

88. As the oil companies would be required to pay a sum depending on the total sales of the alcohol blend, the amount of extra book-keeping required would be reduced to a minimum.

89. Since the distiller gets his raw material at a fixed price and the price of the product is also fixed, he would be able to secure the benefit of any increase in efficiency that he can introduce in his own organisation.

90. The distiller would be expected to produce a minimum quantity of alcohol from a given amount of raw material. A certain margin below the standard yield would be permitted, but deficiencies below this would be regarded as loss and steps would be taken to prevent the use of "power alcohol molasses" for unwarranted purposes.

91. Addition of denaturant.—The addition of a denaturant appreciably increases the cost of power alcohol. Moreover, power alcohol, when available to the public, will be mixed with petrol and will be non-potable. The possibility of eliminating the need of a denaturant has therefore been considered carefully. It is agreed, however, that this will not be feasible. Undenatured power alcohol would, from the excise point of view, be classed as "high strength rectified spirit " on which a duty at the high rate applicable to Indian-made foreign liquor (roughly Rs. 40/- per L. P. gallon) is normally charged. Any leakage in transit would, therefore, constitute a direct threat to the revenues of a province.

92. It is considered that the most suitable denaturant for power alcohol would be petrol. Admixture of 5 per cent petrol with power alcohol should be made at the distilleries before it is sent out for transport to the mixing depots. The distilleries should store adequate amount of petrol for this purpose. The cost of actual mixing in the denaturing vats will be very small. At the mixing depots corresponding deduction in the admixture of petrol should be made.

93. Subsidiary Industries.—Attention should be paid to the development of manufacture of solvents such as butyl alcohol and amyl alcohol ; and for the production from ethyl alcohol, of such chemicals as acetic acid, acetaldehyde, ethyl acetate, ether, chloroform, etc.

94. Efforts should also be made to utilise the spent effluent from the distilleries for the recovery of potash and other materials ; and for the manufacture of "dry ice" from carbon dioxide, which is produced in the process of manufacture of alcohol.

95. Uneconomical distilleries in India.—Many of the distilleries in India are old, a few dating back to 1880. The concentration of wash is usually too low and the utilisation is imperfect ; proper biological control of yeast is mostly neglected ; heat exchangers are not usually provided and the exhaust steam is not utilised ; and lastly the fuel consumption is higher than in properly designed modern distilleries. Some of the distilleries will have to be scrapped and many will need complete rehabilitation. A careful survey of the plants should be carried out and a target of efficiency set.

96. Fabrication of Distilleries.—The Panel is of opinion that distilery plants can and should be fabricated in this country. Patent rights should be acquired, where necessary, by the Central Government from

the foreign manufacturers. Licenses for the manufacture of plants should be given only to approved parties, who should receive all necessary assistance from the licensing authorities in receiving raw materials for manufacture at a reasonable cost.

97. It is claimed that foreign plants of the latest design are more efficient both as regards recovery of alcohol and consumption of steam. This claim is not fully admitted by those in charge of distilleries designed and fabricated in India. Some of the distilleries fabricated in this country are working satisfactorily. The fuel consumption is rather high but this is due to factors which can be rectified. If, however, foreign manufacturers are prepared to guarantee appreciable increase in efficiency and lower steam consumption or the Indian fabricators are unable to undertake the manufacture and supply, licences may be given for the import of a few plants. In the meantime, patents rights should be acquired for exploitation in the country.

98. Details of the cost of erection of new distilleries in India are shown in Appendix XVII. It will be seen that the cost of a modern distillery of one million gallons capacity will be about rupees 9 lakhs, of which amount between 25 to 30 per cent will have to be spent on imported units of plants.

99. Number of New Distilleries Required and Cost of Erection.—Calculating on the basis of yield of molasses at 30 per cent of the quantity of sugar produced, the annual production of molasses will be 4,80,000 tons when the target production of sugar of 16,00,000 tons per year is reached. It is believed that market will be found for about 50,000 tons of molasses annually for purposes other than the production of alcohol. The balance of 4,30,000 tons would suffice for the manufacture of about 26 million gallons of alcohol annually, of which 20 million gallons would be power alcohol.

100. There are a number of existing distilleries, which on examination might pass the efficiency test. A few others could be refurbished so as to work efficiently. It is believed that it would be possible to produce 5 million gallons of alcohol in these distilleries, so that we should have to provide new equipment for the production of about 20 million gallons of alcohol yearly. This production could be achieved by the erection of 20 new distilleries of modern type of one million gallons capacity each during the next 5 years. As has been indicated in Appendix XIX, it will be more convenient in some areas to have smaller plants, while in other areas the sizes of the plants may be larger. The total cost of erection of the new plants will be two crores of rupees approximately.

101. Production of Power Alcohol from Sources other than Molasses.—The Panel is of the opinion that it is not possible in the present circumstances to recommend the manufacture of power alcohol from sources other than molasses, as such manufacture is not likely to be economical. It is most important, however, that efforts should be made to develop an alternative cheap indigenous source of production of power alcohol and rectified spirit, simultaneously with the full development of the power alcohol production outlined in this report. The greater portion of the available molasses will be used up in making power alcohol, and the demand for alcohol for industrial purposes, which is likely to increase steadily with the growth of the fine chemicals, drugs and other industries, will be difficult to meet satisfactorily, unless means are found to increase the total production of alcohol.

102. Research Organisations.—Research organisations should be established to work out improvements in the manufacture of alcohol and to keep abreast with the latest developments. These should carefully explore the possibility (a) of manufacture of industrial and power alcohol from sources other than molasses at economical prices; (b) of utilisation of alcohol for the manufacture of different chemicals ; and (c) of its employment in various industries.

103. Excise Duty on Industrial Alcohol.—The Panel consider that in order to encourage industries using alcohol as raw material it is necessary, as in the case of salt, not to charge any excise duty on alcohol used for industrial purposes other than as motor fuel.

104. Inter-Provincial Excise Barriers.—The manufactureres and distributors of spirituous preparations and products containing alcohol have been greatly inconvenienced and handicapped owing to the existence of inter-provincial excise restrictions. It is recommended that all inter-provincial barriers regarding labelling, bottling, etc., of industrail alcohol and spirituous preparations should be abolished and the whole of India should be treated as one unit.

FOOD YEAST

105. The report of the special Officer appointed by the Food Department on food yeast has been carefully considered (Appendix XXIII). The Panel is of opinion that the main difficulty regarding food yeast is not connected with the production, but with the consumption of the article. No proper scheme for the mass administration of food yeast has been worked out or seems feasible in the near furture. In the absence of such a scheme it is felt that the demand for food yeast in the country, at least in the beginning, would be small and there would be considerable difficulty in disposing of an annual production of 3,000 tons. It would therefore be desirable that instead of putting up a factory of the latter capacity, Government should at the outset encourage sugar factories or other manufacturers to put up small units with a production capacity of 1 ton daily or higher.

106. The Government should guarantee to take over the entire production of such factories during the first 3 years at a fixed price. Tenders should be invited from intending manufacturers on this basis.

107. The responsibility for the distribution of food yeast should be taken up by the Government. Food yeast may be tried in the first instance in institutions ; but its use should at the same time be encouraged both in rural and urban areas by propaganda through all available means.

108. The quality of food yeast should be standardised ; its production should be licensed ; and there should be adequate arrangements for inspection and testing.

109. The details of the cost of installation of a 1 ton per day plant have been worked out, and are shown in Appendix XVIII. General estimates for the cost of erection of larger plants as well as estimates, for the cost of production of food yeast in plants of diffirent sizes are also given. It will be seen that the cost of 1-ton per day plant will be about rupees 4 lakhs, including the cost of boiler house and generator. The plant would be suitable for operation by a sugar factory.

RECOMMENDATIONS OF THE PANEL.

Sugar Industry.

110. Target of production :—The target of production at the end of 5 years should be 16 lakhs tons of sugar ; 15½ lakhs for internal consumption and 50,000 for export outside India.

111. Expansion of existing units.—Factories with a crushing capacity of more than 250 tons and less than 800 tons daily should be encouraged to expand to the latter capacity, if there are reasonable prospects of extra cane being found within an economic distance. All factories should be allowed to improve their efficiency by installing upto 2 sets of cane knives and upto 17 rollers and enlarge their boiling house capacity.

112. Installation of new sugar factories :—It is recommended that 20 new units each of annual production capacity of 10,000 to 12,000 tons of sugar, should be installed as early as possible.

113. Location of new factories :—It is understood that the Government of India has already given its approval to the erection of 5 new sugar factories, one each in Travancore, Hyderabad, Baroda, N.- W. F. P. and Bihar. Sites, therefore, remain to be chosen for only 15 new units. It is recommended that 3 of the units should be allotted to Madras, 3 to Bombay (one of which may be reserved for the Deccan States group), 3 to the Punjab (1 being reserved for the Punjab States) , 3 to Bengal, 1 to Assam, 1 to Orissa and 1 to Sind.

114. Time limit within which preliminary arrangements for new projects must be completed :—As the need for increasing production is urgent, the promotors of new projects should be allowed a period of not more than eighteen months within which to make all preliminary arrangements, financial and otherwise, and to place final orders for machineries. If the provinces to whom additional units are allotted are not able to make these arrangements within two years, the lapsed capacity should be allotted elsewhere. The order in which such capacity should be allotted to ther parts is suggested in para. 21 of the report. Similarly, if the estimated increaase of production by one lakh tons by way of the extension of the existing factories does not take place within a period of 30 months, the position should be re-examined and the shortage made up by fresh allocation of new plants.

115. Shifting of sugar factories :—It may be necessary in certain cases, when factories cannot get sufficient cane to meet their daily requirements or cannot run for an average number of days for want of cane to split and shift part of factory to some other area. This will be permissible provided the aggregate crushing capacity of these split up units does not exceed the capacity of the original plant.

116. Need for State Control :—It is not necessary or desirable to run the sugar industry under State ownership or management. State control over the production, prices and distribution of sugar is, however, necessary.

117. Matters to be subjected to Central Control :—It is recommended that the following matters should be subject to Central Government control, which should, however, be exercised in close collaboration with the Local Governments :—

(a) location of new factories and of existing factories when shifted to new sites ;

(b) sizes and specification of plants and additions to and alterations in extisting units, with the object of ensuring that the crushing capacity does not exceed the capacity sanctioned ;

(c) prices of sugarcane and sugar ;

(d) production of sugar including allotments of quotas to various regional and individual factories ;

(e) distribution of sugar including allocation of sales quotas to individual producing areas and factories and allocation of supplies from individual factories to various regions with a view to avoid cross haulage and to minimise the cost to consumers. In doing this the normal markets in pre-war days of factories should be taken into consideration ;

(f) the fixation of carry over each year and its distribution amongst the factories ;

(g) conditions of labour ;

(h) exports including control over policy, quota packing and prices ; and

(i) production, quality and prices of special sugars and confectionery.

118. Existing Local Legislation to be abrogated :— All provincial legislation dealing with matters proposed to be brought under the Central control will have to be abrogated and replaced by a Central statute. Provinces will obtain delegated powers in respect of functions entrusted to them. All local cesses on cane should be abolished if they are incompatible with the all-India control and policy.

119. Central executive Authority :—The executive powers as regards Central control should be vested in an official Controller. He should have a representative central Board consisting of not more than 7 representatives of the Governments of various regions, 7 representatives of the industry, 2 of consumers, 4 of cane-growers and 2 of labour to advise and assist him on matters of policy, and a small Technical Committee to advise on problems regarding the tensions of factories, replacement of machinery and generally on matters affecting the technical efficiency of the industry.

1.20 Marketing Organisation :—The actual distribution of sugar should be by an organization the membership of which should be compulsory for all sugar factories. This marketing organisation or the controller should levy a charge of one or two annas per maund to meet any financial obligations regarding export, and to compensate individual factories, if necessary, for strong sugar, surplus to the requirements of any particular year.

121. The need for Indian States having a common policy :—The Panel considers it desirable that the policy of the Indian States in respect of the production prices and distribution of sugar should be in line with the all-India policy. The States should participate in the operation of the all-India control on the same basis as the British Indian provinces.

122. Reduction in the price of sugar desirable : measures required :—Efforts should be made to reduce steadily the cost of sugar. This is the only sure way to lead to a greater consumption of sugar in the country. The cost of sugarcane is a most important item in the cost of sugar. It is essential that steps should be taken to produce sugarcane cheaper and achieve a higher recovery of sugar from cane. The lowering of cost of sugar should salso be achieved by increasing the efficiency of the factories, limiting of prafit and lowering of the excise duty.

123. Protection to continue :—It will be necessary to continue the tariff protection during the next 5 years. The quantum of protection required will, however, depend on the comparative cost of production in this country and Java when normal conditions return. The matter will have to be considered in due course by the Traiff Board Meanwhile the existing duty should be extended.

124. Excise duty.—Excise duty is directly related to the import duty the existing import duty is at a level which enables Indian sugar industry to compete with Java after the payment of excise. The imposition of excise duty, however, increases the cost of sugar to the consumer and results in curtailment of consumption. It is recommended accordingly that both the excise duty and the protective duty should be gradually reduced.

125. Khandsari sugar to pay the same excise duty as sugar produced by vacuum pan factories :—The excise duty on Khandsari sugar is at present Re. 0-8-0 per cwt. as against Rs. 3 per cwt. on sugar produced by vacuum pan factories. The Panel is of opinion that Khandsari is a wasteful process of producing sugar and the quality of the production is inferior. The special concession at present granted to Khandsari sugar should be withdrawn and the same excise duty should be levied on it as on sugar produced by vacuum pan factories.

126. Bounties and expert advisory service :—The Panel is of opinion that the sugar industry does not need any bounties as it is receiving and will presumably continue to receive the necessary protection through the Tariff Policy. It does not also require any special expert advice from abroad, except for fabrication of machinery. A competent advisory service should, however, be organised to inspect factories and to help them in improving their technical efficiency. The existing Institute of Sugar Technology should be able to give this service provided its staff and equipment are suitably augmented.

127. Need for intensification of agricultural and technological research :—Research both agricultural and technological, should be intensified with particular reference to the conditions in the differenct parts of the country. The present Central Government grant of 0-1-0 anna per cwt. from excise duty should be increased to 0-4-0 annas per cwt.

128. Utilisation of by-products :—In addition to the measures to be adopted for the proper utilisation of molasses by the production of power alcohol and food yeats, steps should be taken to organise research to make suitable use of press mud and bagasse.

129. Comparative duty on finished machinery and raw materials for manufacture of machines :—The Panel is of opinion that the duty on component parts or raw materials from which machinery for the sugar industry is made should, in no circumstances, be higher than the duty on finished machinery.

130. Confectionery and special sugars :—The manufacture of confectionery and products such as sugar cubes, demerara sugar, icing sugar, jams and squashes should be encouraged. The Tariff Policy in respect of manufactured goods of which sugar is an important ingredient should be revised by increasing the import duty on them to a level

that would place the sugar imported in indirect forms at par with ordinary imported sugar.

131. Requirement of capital goods :—It is estimated that the total cost of machinery required for (a) fuller exploitation of the existing capacities of the sugar factories ; (b) enlargement of the capacity of the existing small plants ; and (c) construction of 20 new factories of 1,000 tons cane per day capacity will be about rupees 11 to 12 crores. It is most desirable that sugar machinery should be fabricated as far as possible in India. Prices of machinery abroad are now abnormally high and they are difficult to obtain. Machinery produced in India may be cheaper and will be available earlier. The latter is an important consideration for enabling us to carry out the programme of expansion according to schedule. The Panel recommends that a central expert organization should be set up for ascertaining requirements, for classifying consolidating them for the programming of supply, for the preparation and supply of design and for organising contacts between factory owners and engineering workshops.

POWER ALCOHOL.

132. Object of developing the power alcohol industry : Target of production:— It is desirable to develope the power alcohol industry in India with the objects primarily :

(a) of establishing an alternative source of motor fuel partially to re-place petrol the indigenous supply of which in the country is short ; and

(b) of utilising the surplus of molasses which is wasted at present.

The Panel recommends that 20 million gallons of power alcohol per annum should be produced from molasses by the end of the next 5 years.

133. Power alcohol to be used as motor fuel in admixture with petrol : Most suitable mixture :—Power alcohol should be used as motor fuel in admixture with petrol. A mixture of 20% power alcohol and 80% petrol is considered most suitable for this purpose.

134. Size of distilleries :—The standard size of distilleries for the production of power alcohol hould be of 1 million gallons capacity, but a smaller size of half a million gallons capacity may be allowed in special areas having a smaller output of molasses. Units larger than 1 million gallons capacity may also be permitted in certain cases.

135. Ownership of distilleries :—Sugar factories should be divided into groups each capable of meeting the molasses requirements of one distillery. Each distillery may be owned jointly by factories supplying the molasses, hare of each sugar factory in the distillery being in proportion to its capacity for supplying molasses.

136. Supply of molasses :—While the sugar factories might be given an option to join as shareholders of the distillery, the selling of molasses to the distillery in proportion to the crushing capacities of the factories should be made compulsory.

137. Licensing of distilleries :—It is proposed that all distilleries should be licensed.

138. Survey of the existing distilleries :—A careful survey should be made to find out which of the existing distilleries are properly situated in respect of their supply of molasses and could be suitably refurbished and extended for the economical production of alcohol. These should be given an opportunity to expand to the prescribed limit. If they are unable to make the necessary extenstions, they should be replaced by new ones. It may be worthwhile in certain cases where the distilleries are wrongly located to shift these to more suitable places and the Government might meet a part of the cost of removal in such cases.

139. Location of standard distilleries :—The standard sized distilleries should be situated mostly in the United Provinces and Bihar which are the main sugar producing areas. Suggestions have been made for the location of 20 distilleries for the production of power alcohol and for the grouping of the sugar factories for supply of molasses to these distilleries.

140. Mixing :—The mixing of power alcohol with petrol should be compulsory in such proportions as might be prescribed and in such areas as are notified from time to time. The mixing should be carried out in the petrol storage depots at present run by the different oil companies.

141. Areas supplied by power alcohol and petrol mixture :—Power alcohol should at first be put in use in the United Provinces and Bihar and areas round them where it would be easily available in required quantities. The total areas supplied by the mixture should progressively expand with the increasing production of power alcohol.

142. Control over power alcohol and molasses : Appointment of Alcohol Commissioner :—The production, distribution and price of power alcohol and the movement, price and quality of molasses should be under the control of the Central Government. The control should be exercised by an Alcohol Commissioner appointed by the Central Government. The Sugar Controller might, with advantage, be appointed as the Alcohol Commissioner in addition. He should be assisted by a Committee having the same powers as in the case of sugar.

143. Expert adviser :—The appointment of a firm or firms as consultants, is not considered to be necessary, but it is desirable that an expert should be attached to the Alcohol Commissioner to help and advise the industry on the fabrication of plants and the production of alcohol.

144. Transport of molasses and power alcohol : Necessity for the reduction of Railway freights :—The development of the power alcohol industry will lead to a large increase in the traffic in molasses and power alcohol. In order to reduce the selling price of power alcohol which would make its use feasible, it is essential that the railway freight for power alcohol and molasses should be kept as low as possible.

145. Sales organisation :—The distribution and sale of power alcohol should be carried out for the present by the existing oil companies. A scheme for the marketing of power alcohol on an all-India basis at a uniform price has been worked out.

146. Addition of denaturant :—The addition of denaturant appreciably increases the cost of power alcohol. The Panel, however, considers that it will not be practicable to eliminate the use of denaturant. The most suitable denaturant for power alcohol would be petrol. 5% petrol should be added to power alcohol before it is sent out of the distilleries for transport to the mixing depots.

147. Cost of power alcohol :—It is considered that on the basis of 6 annas per maund as the price of molasses, the cost of production of power alcohol in standard distilleries of capacity of 1 million gallons per annum would be about 8 annas per gallon. The cost of power alcohol to the consumers might be somewhat higher than that of petrol, although the mixed full which will contain only 20% power alcohol should not cost more than 1½ to 2 annas per gallon higher than that of unmixed petrol.

148. Excise duty on power alcohol :—The Panel considers that in view of the strategic importance of the development of the power alcohol industry an excise duty lower than that on petrol should be charged on power alcohol so that power alcohol. petrol mixture may be available to the consumers at the same price as unmixed petrol

149. Fabrication of distilleries : Cost of Erection :—New equipment will have to be provided for the manufacture of 20 million gallons of power alcohol per annum. The total cost of erection of the new plants is estimated to be about rupees two crores. As far as possible the distillery plants should be fabricated in this country. Patent rights should be acquired by the Central Government where necessary from the foreign manufacturers.

150. Production of power alcohol from sources other than molasses :—The Panel is of opinion that it is not possible in the present circumstances to recommend the manufacture of power alcohol from sources other than molasses as such manufacture is not likely to be economical. It is most important, however, that efforts should be directed to the development of alternative cheap indigenous sources of production of power alcohol and rectified spirit.

151. Subsidiary Industries: —Attention should be paid to the development of the manufacture of solvents such as butyl alcohol and amyl alcohol, and for the production from ethyl acetate, ether, chloroform, etc. Efforts should also be made for suitable utilisation of the spent effluent from the distilleries and for the manufacture of "dry ice" from carbon dioxide which is produced in the process of manufacture of alcohol.

152. Research Organisation :—Research organisation should be established (a) to work out improvements in the manufacture of alcohol ; (b) to keep abreast with the latest developments in other countries ; (c) to explore sources other than molasses for the manufacture of industrial and power alcohol at economical price ; and (d) to develop the use of alcohol in various industries and its utilisation in the manufacture of different chemicals.

153. Excise duty on industrial alcohol :—The Panel considers that in order to encourage industries using alcohol as raw material, it is necessary, as in the case of salt, not to charge any excise duty on alcohol used for industrial purposes other than as a motor fuel.

154. Inter-provincial excise barriers :—It is recommended that all inter-provincial barriers regarding labelling, bottling, etc., of industrial alcohol and spirituous preparations should be abolished and whole of India regarded as one unit.

FOOD YEAST.

155. The Panel is of opinion that the main difficulty regarding food yeast is not connected with the production, but with the consumption of the article. The demand for food yeast in the country in the beginning is likely to be small and the Panel thinks that there will be considerable difficulty in disposing of an annual production of 3,000 tons recommended by the special officer of the Food Department.

156. The Government of India should at the outset encourage sugar factories or other manufacturers to put up small units with a production capacity of about 1 ton a day. The cost of erection of such a unit will be about Rs. 4 lakhs including the cost of boiler house and generator.

157. The Government of India should guarantee to take over the entire production of such units during the first 3 years at a fixed price and should take up the responsibility for the distribution of food yeast.

158. Food yeast may be tried in the first instance in institutions ; but its use should at the same time be encouraged both in rural and urban areas by propaganda through all available means.

159. The quality of food yeast should be standardised ; its production should be licensed ; and there should be adequate arrangements for inspection and testing.

Shri Ram	Chairman.
R. C. Srivastava	
Vishnu Sahay	
S. M. Dhar.	
*B. C. Guha	
*Lalchand Hirachand	
M. B. Amin	
*W. H. A. Webb	
Shankar Prasad	
Karamchand Thapar	
Gursharan Lal	Members.

M. K. Maitra — Secretary.

* Signed subject to the notes at page 33.

NOTE BY MR. LALCHAND HIRACHAND.

While I sign this report I should like to add a note to clarify some of my ideas. Personally I think that it would be unwise to impose the controls too rigidly whereby the initiative of the enterpriser will be lost. In this connection I would particularly draw the attention to (2) of paragraph 22 by which it is proposed to restrict alterations in plant. To prevent unauthorised increase in crushing capacity the best thing is to give production quota and leave the internal organisation entirely to the Factory management. The controls should, therefore, be restricted to safeguarding certain interests such as labour, the grower and the consumer and should be enforced in such a way that the Industry will be able to maintain its progress.

NOTE BY DR. B. C. GUHA.

1. I would not agree with the proposed distribution of the new sugar factories. Bengal is both a large consuming province for sugar and has also a soil which is very suitable for the production of cane. From both these points of view Bengal is in a better position than many other provinces. I would suggest the number of sugar factories allotted to Bengal should be raised from 3 to 4. The relative lack of development of the sugar industry in Bengal should be no justification for the refusal to allot 4 new factories to that province. It should, however, be stipulated that unless the construction of these 4 factories is under way within two years, these factories may be allotted to other provinces. It is obvious that if producing and consuming areas largely coincide, that is the best arrangement from every point of view and that is an essential part of industrial planning.

2. Regarding food yeast, I do not agree with the recommendation of the Panel. A Food Yeast factory with a capacity for the production of 10 tons a day would be much more economic than units with a capacity for the daily production of one ton. If yeast is to be fed to the poorer sections of the population who are mal-nourished, the material should be produced at as low a cost as possible. Even a factory with a production capacity of 10 tons a day producing roughly 3,000 tons a year would produce just enough material to feed about one million people. This is indeed a very small proportion of the total population of India. It should not be difficult to arrange distribution of this amount of yeast to selected groups of people, particularly the vulnerable groups of the population, in selected institutions. This factory should preferably be established by Government who should also supervise distribution. This does not preclude other manufacturers from putting up small units with whatever production capacity they desire.

NOTE BY MR. W. H. A. WEBB.

As I understood it, my appointment to the Panel on Sugar, Alcohol and Food Yeast was in the capacity of a technician having knowledge of Alcohol and Food Yeast manufacture and machinery. No other technician with experience of this equipment was a member.

As such a technician I have avoided all questions concerning Sugar and all questions of policy unless Technical considerations played an important part in them.

In my view, the recommendations of the Panel are not always in line with the creation of an efficient Alcohol Industry nor do I think the Wide Issue of Food Yeast has had fair consideration.

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APPENDIX I.

Acreages under Cane in the different Provinces and States.

Provinces.	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1941-42	1942-43	1943-44
U. P. (Including Rampur).	1,593,000	1,793,000	1,734,000	1,840,000	2,249,000	2,515,000	2,222,000	1,652,000	1,909,000	2,539,000	1,745,000	1,897,000	2,192,030
Punjab ...	475,000	558,000	466,000	462,000	474,000	554,000	510,000	354,000	417,000	547,000	456,000	447,000	553,000
Bihar and Orissa	282,000	302,000	418,000	445,000	478,000	441,000	394,000	407,000	474,000	543,000	416,000	436,000	456,000
Bengal ...	233,000	283,000	257,000	276,000	325,600	355,000	290,000	299,000	316,000	331,000	314 000	303,000	339,000
Madras ...	117,000	125,000	120,000	122,000	119,000	122,000	178,000	98 000	138,000	162,000	112,000	122,000	148,000
Bombay and Sind	99,000	105,000	103,000	114,000	127,000	136,000	128,000	121,000	153,000	159 000	165,000	158,000	169,000
N.-W.F.P. ...	44,000	53,000	49,000	43,000	59,000	71,000	70,000	51,000	71,000	96,000	85,000	77,000	90,000
Assam ...	31,000	32,000	35,000	35,000	37,000	40,000	39,000	38,000	38,000	41,000	40,000	44,000	45,000
C. P. and Berar	22,000	28,000	29,000	29,000	30,000	32,000	34,000	29,000	30,000	31,000	32,000	36,000	29,000
Delhi ...	3,000	4,000	3,000	8,000	3,000	5,000	6,000	1,000	1,000	3,000	2,000	2,000	3,000
Hyderabad ...	35,000	40,000	46,000	51,000	59,000	58,000	30,000	29,000	36,000	45,000	41,000	35,000	37,000
Mysore ...	36,000	42,000	42,000	46,000	51,000	52,000	50,000	45,000	49,000	51,000	46,000	42,000	40,000
Baroda ...	2,000	2,000	2,000	2,000	3,000	3,000	3,000	2,000	2,000	8,000	3,000	4,000	4,000
Bhopal ...	—	4,000	4,000	4,000	6,000	6,000	5,000	4,000	6,000	3,000	9,000	6,000	7,000
Miscellaneous Areas.	—	—	—	—	—	142,000	128,000	140,000	148,000	151,000	156,000	156,000	156,000
Total ...	2,972,000	3,321,000	3,308,000	3,477,000	4,020,000	4,582,000	3,987,000	3,270,000	3,788,000	4,710,000	3,622,000	3,755,000	4,268,000

APPENDIX II

Yields of Cane in different Provinces in 1943-44.

Provinces.	Area under Sugar cane in 1943-44.	Yield of Cane 1943-44.	Yield of Cane per Acre.
1	2	3	4
	(Acres)	(Tons)	(Tons)
U.P. (including Rampur) ...	2,192,000	27,900,000	12.7
Punjab	553,000	5,730,000	10.4
Bihar and Orissa	456,000	5,380,000	11.8
Bengal	339,000	4,800,000	14.2
Madras	148,000	4,180,000	58.2
Bombay and Sind	169,000	5,290,000	31.3
N.-W.F.P.	90,000	1,000,000	11.1
Assam	45,000	500,000	11.1
C.P. and Berar	29,000	430,000	14.8
Delhi	3,000	20,000	6.7
Hyderabad	37,000	800,000	21.6
Mysore	40,000	700,000	17.6
Baroda	4,000	160,000	40.0
Bhopal	7,000	50,000	7.1
Miscellaneous Areas	156,000	2,170,000	—
Total ...	4,268,000	59,110,000	13.8

APPENDIX III.

Quantities of cane crushed by factories in the different Provinces (In Tons).

Provinces.	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1941-42	1942-43	1943-44
United Provinces	851,000	1,641,000	3,015,000	3,685,000	5,533,000	6,304,000	5,786,000	3,505,000	7,034,000	5 199,800	3,877,000	6,028,000	7,332,400
Bihar ...	754,000	1,495,000	1,688,000	2,093,000	2,803,000	3,580,000	2,350,000	1,795,000	3,446,000	2,494,000	1,133,600	2,171,900	2,018,000
Orissa ...				—	—	232,000	16,000	9,000	27,000	84,200	31,800	21.100	17,600
Madras ...				160,000	191,000	—	218,000	246,000	843,000	482,000	352,000	291,000	420,400
Punjab Sind and N.-W.F.P.				67,000	113,000	164,000	139,000	87,000	175,000	242,000	215,700	129,600	174,200
Bombay ...	179,000	214,000	459,000	200,000	283 000	358,000	371,000	463,000	632,000	852,400	861,100	732,000	739,700
Bengal and Assam				141,000	295,000	280,000	222,000	131,000	430,000	611.300	313,600	199,600	175,900
States ...				204,000	663,000	770,000	814,000	768,000	1,024,000	1,874,200	1,241,200	845,300	1,259,200
	1,784,000	3,350,000	5,157,000	6,550,000	886,000	11,688,000	9,916,000	7,004,000	13,181,000	11,290,900	8,026,300	10,418,500	12,137,800
Burma ...	—	—	—	122,000	148,000	187,000	287,000	220,000	265,000	284,800	—	—	—

APPENDIX IV.

Average number of days of actual working in sugar factories in different Provinces.

	1932-33	1933-34	1934-35	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1941-42	1942-43	1943-44
United Provinces ...	136	112	107	134	140	124	77	133	100	78	112	131
Bihar ...	149	105	109	124	150	99	79	136	100	54	96	93
Rest of India ...	112	84	90	112	125	103	97	119	144	117	89	110
India ...	138	106	104	126	138	112	83	129	113	85	101	117

APPENDIX V.

Production of Sugar Directly from Cane in Modern Factories in India, 1930—1944.

Season.	Number of Factories producing Sugar direct from Cane.	Cane Crushed.	Sugar Produced.
		(Tons)	(Tons)
1930-31	29	1,317,248	119,859
1931-32	32	1,783,499	158,581
1932-33	57	3,350,231	290,177
1933-34	112	5,157,373	453,965
1934-35	130	6.552,030	568,465
1935-36	137	9,885,748	919,100
1936-37	137	11,687,200	1,111,400
1937-38	136	9,916,400	930,700
1938-39	139	7,004,800	650,800
1939-40	145	13,131,700	1,241,700
1940-41	148	11,290,900	1,095,400
1941-42	150	8,026,300	778,100
1942-43	150	10,418,500	1,070,700
1943-44	151	12,137,800	1,216,400

APPENDIX VI.

Quantities of sugar produced in the different Provinces. (In Tons)

Provinces.	1931-32	1932-33	1933-34	1934-35	1935-36	1936-37	1937-38	1938-39	1939-40	1940-41	1941-42	1942-43	1943-44
United Provinces	73,000	140,000	274,000	316,000	530,000	609,000	531 000	320,000	660,000	513,300	382,000	612,500	727,100
Bihar ...	68,000	129,000	140,000	184,000	250,000	329,000	225,000	162,000	322,000	246,100	117,300	237,400	219,400
Orissa ...				—	—	21,000	1,000	1,000	2,000	3,000	3,000	2,100	1,700
Madras ...				15,000	18,000	—	21,000	23,000	31,000	44,100	30,800	27,500	39,200
Punjab, Sind N.-W.F.P.				4,000	9,000	15,000	12,000	7,000	15,000	21,800	19,200	11,800	17,400
Bombay ...	17,000	21,000	40,000	21,000	30,000	38,000	41,000	52,000	69,000	84,000	85,000	77,900	81,200
Bengal and Assam	—	—	—	11,000	24,000	24,000	20,000	10,000	40,800	52,000	23,700	16,500	13,600
States ...	—	—	—	18,000	58,000	75,000	80,000	76,000	103,000	130,300	116,200	85,000	122,800
Total ...	158,000	290,000	454,000	569,000	919,000	1,110,000	931,000	651,000	1,242,000	1,095 400	778,100	1,070,700	1,216,400
Burma ...	—	—	—	9,650	13,000	18,000	27,000	22,000	28,000	29,200	—	—	—

APPENDIX VII.

Recoveries of sugar and molasses per cent. cane.

Year.	Recovery for U. P.		Recovery for Bihar.		Recovery for the rest of India.		Recovery for India as a whole.	
	Sugar.	Molasses.	Sugar.	Molasses.	Sugar.	Molasses.	Sugar.	Molasses.
1931-32 ...	8 59	3·87	9·06	3·88	9·60	3·90	8·89	3·89
1932-33 ...	8·55	3·93	8·60	3·87	8·90	3·72	8·66	3·89
1933-34 ...	9·08	3·65	8·32	3·63	8·75	4·20	8·80	3·69
1934-35 ...	8·56	3·41	8·79	3·43	8·77	4·08	8·66	3·50
1935-36 ...	9 30	3·30	8·93	3·47	9·00	3·91	9·29	3·44
1936-37 ...	9·65	3·30	9·2	3·73	9·00	3·59	9·50	3·48
1937-38 ...	3·18	3·58	9·58	3·39	9·77	3·53	9·38	3·53
1938-39 ...	9·44	3·47	9·00	3·31	9·91	3.95	9·29	3·46
1939-40 ...	9·37	3·67	9·29	3·62	9·84	3·85	9 45	3·69
1940-41 ...	9·87	3·64	9·86	3·74	9·34	3·94	9·70	3·76
1941-42 ...	9·87	3·37	10·35	3·30	9·22	4·14	9·69	3·65
1942-43 ...	10·16	3·52	10·93	3·42	9·95	8·71	10·28	3·54
1943-44 ...	9·92	3·58	10·53	3·39	9·94	3·87	10·02	3·61

APPENDIX VIII.

Table showing quantity of Molasses produced in the different Provinces in India during the last ten years

Provinces.	1934-35.	1935-36.	1936-37.	1937-38.	1938-39.	1939-40.	1940-41.	1941-42.	1942-43	1943-44.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons	Tons.	Tons.
U. P.	126,000	183,000	208,000	207,000	122,000	258,000	189,300	130,700	212,300	262,600
Bihar	72,000	97,000	134,000	80,000	60,000	126,000	98,500	37,400	74,400	68 800
Orissa			10,000	1,000	...	1,000	1,600	1,500	900	800
Madras	7,000	8,000		8,000	9,000	15 000	20,700	16 600	11,300	17,900
Punjab, Sind and N.-W.F. Provinces.	3,000	5,000	5,000	5,000	3,000	7,000	10,100	7,400	4,500	5,500
Bombay	7,000	10,000	12,000	13,000	15,000	24,000	35,400	38,600	28,600	28,700
Bengal and Assam ...	5,000	11,000	10,000	7,000	4,000	16,000	26,100	12,700	6,600	8,200
States	8,000	17,000	28.000	29,000	29,000	38,000	47,900	48,000	30,500	46,700
Total ...	228,000	331,000	407,000	350,000	242,000	485,000	424,600	292,900	369,100	438,700
Burma	5 000	7,000	8,000	11,000	7,000	9,000	9,300			

APPENDIX IX.

Consumption and per capita consumption of sugar in the various Provinces and States (with population).

Provinces.	1934-35			1935-36		
	Cosumption. (Tons).	Population in (Millions).	Per Capita consumption lbs.	Consumption. (Tons).	Population in (Millions).	Per Capita consumption lbs.
Bengal...	140,000	53 1	5·9	158,000	54·1	6 7
Bombay ...	243,000	24·5	18·0	212.000	24·9	15·5
Madras... ...	85,000	46·1	3·4	72,000	46·6	2 8
Bihar	57 000(a)	36 4	2·9(a)	62,000(a)	33 8	3·1(a)
U. P.	124,000	51·1	5·4	131,000	51·9	5·6
Punjab	213.000(b)	29.8	13·5(b)	233,000(b)	30·4	14 6(b)
C. P. & Berar ...	40,000	15·6	4·8	40,000	15·7	5·1
Assam	11,000	9·3	2·5	13,000	9·5	3·5
Sind & Br. Baluchistan.	20,000	4·5	8·8	22,000	4·6	9 5
Orissa	(Included in Bihar)	8·2		(Included in Bihar)	8·2	
N.-W. F. P.	Included in Punjab	2·6		(Included in Punjab)	2·6	
Delhi ...		0 7			0·7	
Rajputana ...	49,000	12·0	8 9	53,000	12·2	9·5
C. I.	26,000	10 4	5 5	28,000	10 5	6·1
Nizam's Territory...	17,000	15·0	2·5	18,000	15 2	2·6
Mysore ...	5,000	6·7	1·5	8,000	6·7	2 6
Kashmir ...	2,000	3·6	1·5	2,000	3 6	1·2
Burma	27,000	...	3·9	21,000	...	3·1
All India ...	1,059,000	326,6	6·5	1,074,000	331·2	6·5

(a) Includes Orissa also.

(b) Includes N.-W. F. P. and Delhi also.

APPENDIX IX—*contd.*

Provinces.	1936-37			1937-38		
	Consumption. (Tons).	Population in (Millions)	Per Capita consumption. lbs.	Consumption. (Tons).	Population in (Millions)	Per Capita consumption. lbs.
Bengal	174,000	55·1	7·3	190,000	56·1	7 9
Bombay ...	228,000	25·3	16·2	230 000	25·7	16·3
Madras... ...	100,000	47·1	3·9	100,000	47·6	3·9
Bihar	70,000(a)	34·2	3·5(a)	58,000(a)	34·6	3·3(a)
U. P.	125,000	52·5	5·4	150,000	53·1	6·4
Punjab... ...	265,000(b)	31·0	16·5(b)	206,000	31·6	14 9
C. P. & Berar ...	43,000	15 8	4·9	44,000	6·9	5·0
Assam	17,000	9·7	3·6	18,000	9 8	4·0
Sind & Br. Baluchistan.	25,000	4·7	10·2	30,000	4·7	12·6
Orissa... ...	...	8·3	...	8,000	8·3	...
N.-W. F. P.	... (Included	2·7 in	... Punjab)	22,000	2·7	10·5
Delhi ...	...	0·7	..	10,000	0·8	30·3
Rajputana ...	58 000	12·4	10·6	43,000	12·6	9·9
C. I.	35,000	10 7	6·4	23,000	10 8	4·5
Nizam's Territory	19,000	15·4	2·7	21,000	15·6	3·0
Mysore ...	10,000	6·8	2·9	4,000	6·9	1·3
Kashmir	3,000	3·7	1·7	2,000	3·7	1·2
Burma... ...	...	...	...	...	...	...
All India ...	1,167,000	336·1	7 3	1,159,000	340,6	7·2

(a) Includes Orissa also.

(b) Includes N.-W. F. P. and Delhi also.

APPENDIX IX—*contd.*

Provinces.	1938-39.			1939-40.		
	Consumption. (Tons).	Population in (Millions).	Per Capita consumption. lbs.	Consumption. (Tons).	Population in (Millions)	Per Capita consumption lbs.
Bengal	139,000	57·1	5·8	161,000	58·2	6·7
Bombay ...	244,000	26·2	17·0	219,000	26·6	15·2
Madras... ...	88,000	48·2	3·4	94,000	48·7	3·6
Bihar	50,000	35 0	2·8(a)	57,000	35·4	3·1(a)
U. P.	170,000	53·7	7·1	153,000	54·3	6·3
Punjab	164,000	32·2	11·8	169,000	32·8	12·0
C. P. & Berar ...	37,000	16·2	4·2	38,000	16·4	4·3
Assam	19.000	9·9	4·1	16,000	10·0	3·5
Sind & Br. Baluchistan.	34,000	4·8	14·1	35,000	4·9	14·3
Orissa	8,000	8·4	...	8,000	8·5	..
N.-W. F. P. ...	13,000	2·8	6·2	8,000	2·8	3·8
Delhi	16,000	0·8	44·8	20,000	0·8	44·8
Rajputana ...	37,000	12 8	6·7	38,000	13·1	6·8
C. I.	24,000	11 0	4·6	25,000	11·2	4·8
Nizam's territory ...	19,000	15·8	2·7	20,000	16·0	2·8
Mysore... ...	8,000	7·0	2·6	11,000	7·1	3·5
Kashmir ...	3,000	3·7	1·7	2,000	3·8	1·1
Burma	...	..	...	...	...	...
All India ...	1,073,000	345·6	6·6	1,074,000	350·6	6·5

(a) Includes Orissa also.

(b) Includes N.-W. F. P. and Delhi also.

APPENDIX IX—*concld.*

Provinces	1940-41. Consumption. (Tons).	Population in (Millions).	Per Capita consumption lbs.	1941-42. Consumption. (Tons).	Population in (Millions).	Per Capita consumption lbs.
Bengal	178,000	59·3	6·6	120,000	60.3	4·5
Bombay ...	260,000	27·4	20·8	240,000	27·9	19·2
Madras... ...	106,000	49·2	4·8	90,000	49·7	4·1
Bihar	60,000	35·8	3·9(a)	66,000	36·3	3·6(a)
U. P.	244,000	35 1	9·8	159,000	55·9	6·4
Punjab... ...	231,000	33·4	15·3	199,000	34·0	13·1
C. P. & Berar ...	47,000	16·6	6·3	37 000	16·8	4·9
Assam	20,000	10·1	4·4	11,000	10·2	2·4
Sind & Br. Baluchistan.	44,000	4·9	19·5	39,000	5 0	17·3
Orissa	10,000	8·6	...	7 000	8·7	...
N.-W. F. P. ...	18,000	2·9	13·3	15,000	3·0	11·1
Delhi	22,000	0·9	53·7	14,000	0·9	34 2
Rajputana ...	48,000	13·3	7·9	60,000	13 6	9·8
C. I.	35,000	11·3	6·8	33,000	11·5	6·4
Nizam's territory ...	27,000	16·2	3·7	23,000	16 3	3·2
Mysore... ...	14,000	7·2	4·3	15,000	7·3	4·6
Kashmir ...	3,000	3·8	1·7	4,000	3·9	2·3
Burma... ...	...	...	...	...	...	...
All India ...	1,376,000	356,0	8·5	1,132,000	361·3	7·0

(a) Includes Orissa also.

(b) Includes N.-W. F. P. and Delhi also.

APPENDIX X.

Quantity of sugar exported from Java.

Destination.	1940-41.	1939-40	1938-39.	1937-38.
	Tons.	Tons.	Tons.	Tons
Near and Middle East :—				
Arabia	4,428	8,617	5,941	648
Aden	2,837	16,406	14,124	10,791
Iraq	18,711	24,353	12,202	8,091
Iran	38,247	63,243	10,460	...
Somali Land	203	305	127	...
British East Africa	1,166	3,067	3,766	3,135
Port. East Africa	533	1,208	937	862
Colombo	61,056	88,162	69,670	68,156
Total ...	127,181	205,361	1,117,227	91,633
Far East :—				
Burma	203	6,518	1,840	...
Siam	18,704	16,927	23,354	22,257
British Malaya	732	313	...	
Penang	21,596	19,280	18,160	21,616
Singapore	75,817	72,416	63,166	68,5353
Fr. Indo China	558	786	1,975	1,852
Hong-Kong	165,188	113,938	122,179	90,502
China	78,319	22,094	19,967	33,300
Br N. Borneo	3	174	...	...
Sarawak	537	1,237	...	...
Total ...	361,657	253,683	250,641	238,065

APPENDIX XI.

Factories with capacities below 800 tons per day.

Factory.	Capacity (Tons per day).	Factory.	Capacity (Tons per day)
N. W. F. P. :—		**Orissa :—**	
Takhati-Bhai	400—500	Aska	120
		Rayaghada	200
Punjab :—			
Pattoki	100	**Bengal :—**	
Rahwali	300—450	Bochaganj	750
Abdullapur	400	Plassey	500
		Shomeganj	150
United Provinces :—		Charisindur	300
Doiwala	520	Belacoba	150
Saknotitanda	717	Kishoreganj	300—350
Meerut	650	Bhowanipur	75
Mohiuddinpur	750		
Muradnagar	60	**Assam :—**	
Kichha	750	Deopani	50
Kashipur	600		
Amroha	500	**Madras :—**	
Aira	650	Thummapala	200
Rosa	725	Etikopaka	65
Burhwal	650	Bobbili	150
Aishbagh	793	Seethanagram	300
Nawabganj (Experimental)	28	Kirlampudi	100
Balrampur	700	Hospet	500
Katra	100	Podanur	50
Babhnan	793	Mangalore	60
Tulsipur	700	Mailpatti	75—100
Walterganj	700—800	Pugalur	250
Basti	760		
Kunderwa	700	**Bombay :—**	
Khalilabad	650	Akluj	400
Khadda	761	Ravalgaon	600
Ledi	90	Belvandi	250—300
Siswabazar	620	Sakrvadi	650
Pipraich (Diamond) ...	778	Puntamba	350
Gauribazar	650	Lakshmiwadi	600
Pipraich	213	Boregaon ...	350
Tahsil Deoria	351		
Bhatni	720	**Sind :—**	
Lakshmiganj	700	Mohattanagar	500
Ramkola	777		
Kathkuiyan	400	**Indian States :—**	
Purtabpur	750	Phagwara (Kapurthala State)	700
Jhusi	400	Kolhapur	450
Shahganj	750	Gandevi (Baroda State) ...	280
Naini	250	Sakarwadi (Phalton State)...	650
		Jaora	550
Bihar :—		Sehore (Bhopal) ...	758
Pakri	500—600	Karera (Udaipur) ...	300
Motihari	783	Harpalpur	100
Bagaha	450	Dubra (Gwalior) ...	700
Sasamusa	750	Mahidpur Rd. (Holkar) ...	250—300
Siwan	700	Uggr Khurd (Belgam) ...	500
Mahrajganj	400	Ranbir Singhpur (Jammu State).	500
Sidhwalia	650	Kittur	150
Samastipur	700		
Ryam	700		
Sakri	700		
Buxar	100		
Bikramganj	600		

APPENDIX XII.

Number of Sugar Factories in existence working in India directly for cane and refining for Gur.

Serial No.	Name of Factory.	Location.	Daily cane crushing capacity (Tons.)	Remarks.
WEST U. P. (Dehra Dun, Saharanpur, Muzaffarnagar, Bijnor, Moradabad districts) :—				
1.	The Vijai Sugar Corporation Ld. ...	Doiwala.	450	
2.	The Ganga Sugar Corporation Ld.	Deoband.	800-1000	
3.	Rai Bahadur Narain Singh Sugar Mills Ld.	Lhaksar.	1100-1200	
4.	The Lord Krishna Sugar Mills Ld....	Saharanpur.	1000	
5.	The Amritsar Sugar Mills Co. Ld. ...	Rohana Kalan.	1100-1200	
6.	The Upper Doab Sugar Mills Co. Ld.	Shamli.	1200	
7.	The Upper Jumna Swadeshi Sugar Mills Co. Ld. ...	Mansurpur.	1000-1100	
8.	The Upper India Sugar Mills Ld. ...	Khatauli.	1100-1150	
9.	The Dhampur Sugar Mills Ld. ...	Dhampur.	870	
10.	The Upper Ganges Sugar Mills Ld.	Seohara.	1300	
11.	Seth Shiv Prasad Banarsi Dass Sugar Mills	Bijnor.	1100	
12.	Shri Diwan Sugar Mills ...	Sakhotitanda.	400	
13.	Daurala Sugar Works	Daurala.	1200	
14.	Jaswant Sugar Mills ...	Mohana.	650	
15.	Ram Luxman Sugar Mills Ld. ...	Mohiuddinpur.	750	
16.	Modi Sugar Mills Ld.	Modi Nagar	800	
17.	Simbhaoli Sugar Mills Ld ...	Simbhaoli.	750	
18.	The Muradnagar Sugar Works ...	Muradnagar.	60	Not working.
19.	The Amroha Sugar Factory ...	Amroha.	350	
20.	The Ajudhia Sugar Mills ...	Raja-ka-Sahaspur.	1000-1800	
21.	The Kesar Sugar Works Ld. ...	Baheri.	1400	
CENTRAL U. P. (Nainital, Etah, Bareilly, Pilibhit, Kheri, Shahjahanpur Sitapur, Hardoi, Bara Banki, Lucknow, Cawnpore, Allahabad districts):—				
22.	H.R. Sugar Factory Ld. ...	Bareilly.	800	
23.	The Gokulnagar Sugar Mills Co. Ld	Kisha.	1000	
24.	L.H. Sugar Factories & Oil Mills Ld.	Kashipur.	500	
25.	Neoli Sugar Factory	Manpur-Nagaria.	850	
26.	L.H. Sugar Factories & Oil Mills Ld.	Pilibhit.	1750	
27.	The Hindustan Sugar Mills Ld. ...	Golagokaranath.	1800	
28.	The Aira Sugar Factory ...	Khamaria.	650	
29.	Carew & Co. Ltd,. Rosa ...	Rosa.	725	
30.	The Oudh Sugar Mills Ld. ...	Hargaon.	1800	
31.	The Lakshmiji Sugar Mills Co. Ld.	Maholi.	1650	
32.	The Saksaria Biswan Sugar Factory Ld.	Biswan.	1200	
33.	The Lakshmi Sugar & Oil Mills Ld.	Hardoi.	1400	
34.	The Bhurwal Sugar Mills Co. Ld. ...	Bhurwal.	500	
35.	Ramchand & Sons Sugar Mills ..	Aishbagh.	860	
36.	The Kamalapat Motilal Guraiya Sugar Mills.	(working with Guraiya cane and Gur).	1000-1500	Not working in 1944-45.
37.	The Shree Krishna Deshi Sugar Works.	Jhusi.	400	Not working.
38.	Trebeni Deshi Sugar Works ...	Naini.	400	"
39.	Baijnath Balmakund Sugar Mills ...	Anwarganj.	(Gur only 27)	"
40.	Experimental Sugar Factory IIST. ...	Cawnpore.	28	"
41.	Cawnpore Sugar Works Ld. ...	Cooperganj.	(Gur only 73)	"
42.	The Unao Sugar Mills. ...	Unao.	(Gur only 75)	"

Serial No.	Name of Factory.	Location.	Daily cane crushing capacity. (Tons.)	Remarks
EAST U. P. (Bahraich, Gonda, Basti, Gorakhpur, and Jaunpur districts):—				
43.	R. B. Seth Lachmandas Mohanlal Sugar Mills	Jarwal Road.	600	
44.	The Balrampur Sugar Co. Ld.	... Balrampur.	750	
45.	The Nawabganj Sugar Mills	... (Katra) Nawabganj.	1850	
46.	Shree Sheodayal Sugar Mills Ld.	... Lakarmandi.	100-150	Not working.
47.	The Saksaria Sugar Mills Ld.	... Babhnan.	850	
48.	The Balrampur Sugar Mills Co. Ld.	Tulsipur.	750	
49.	The Basti Sugar Mills Co. Ltd.	... Walterganj.	700-800	
50.	The Basti Sugar Mills Co. Ld.	... Basti.	800	
51.	The Madho Kanhya Mahesh Gauri Sugar Mills Ld. ...	... Munderwa.	600-700	
52.	The Barhni Sugar Mills.	... Barhni.	1000	
53.	Shree Anand Sugar Mills Ld.	... Khalilabad.	400	
54.	The Ganesh Sugar Mills Ld.	... Pharenda.	700-800	
55.	The Lakshmi Devi Sugar Mills Ld.	... Chitauni.	600-700	
56.	The Vishnu Pratap Sugar Works Ld.	Khadda	700	
57.	The Ledi Sugar Factory.	... Ledi.	80	Not working.
58.	The Mahabir Sugar Mills Ld.	... Siswa Bazar.	750	
59.	The Punjab Sugar Mills Co. Ld.	.. Ghughli.	850	
60.	The Shankar Sugar Mills Ld.	... Captainganj.	850	
61.	Diamond Sugar Mills Ld.	... Pipraich.	700-800	
62.	The Pipraich Sugar Mills Ld.	... Pipraich.	300	
63.	Saraya Sugar Mills Ld.	... Sardarnagar.	2000	
64.	Cawnpore Sugar Works Ld.	... Gauribazar.	700	
65.	Shree Sitaram Sugar Co. Ld.	... Baitalpur.	800-900	
66.	Sind National Sugar Mills Ld.	... Deoria.	300	
67.	Noori Sugar Works ...	... Bhanti.	700	
68.	The Ishwary Khetan Sugar Mills Ld.	... Lakshmiganj.	700	
69.	The Maheshwari Khetan Sugar Mills Ld.	... Ramkola (M.K.)	750	
70.	The Ramkola Sugar Mills Co. Ld.	... Ramkola.	900	
71.	The Padrauna Rajkrishna Sugar Works Ld.	... Padrauna.	1000	
72.	The Jagadish Sugar Mills Ld.	... Kathkuiyan.	400	
73.	The United Provinces Sugar Co. Ld.	... Seorhi (Tamkohi Road).	925	
74.	Purtabpore Sugar Factory.	... Mairwa.	800	
75.	Deoria Sugar Mills Ld.	... Deoria.	900	
76.	The Ratna Sugar Mills Co. Ld.	... Shahganj.	750	
77.	Campierganj Sugar Mills Ld.	... Campierganj.	300	Not working.
	UNITED PROVINCES ...	... 62073/64073		
NORTH BIHAR. (Champaran Saran, Muzaffarpur, Darbhanga and Purnea districts).—				
1.	Harinagar Sugar Mills Ld.	... Ramnagar.	1500	
2.	New Swadeshi Sugar Mills Ld.	... Narkatiaganj.	800-900	
3.	Shri Krishna Gyanodoya Sugar Mills.	... Lauriya.	650	
4.	Champaran Sugar Co. Ld.	... Chanpatia.	850-900	
5.	Motilal Padampat Sugar Mills Co. Ld.	... Majhowlia.	1000	
6.	The Sagauli Sugar Works Ld.	... Sagauli	900	
7.	Shree Hanuman Sugar Mills Ld.	... Motihari.	750	
8.	The Champaran Sugar Co. Ld.	... Barrah Chakia.	900-1000	
9.	The Ganga Devi Sugar Mills Co. Ld.	... Bagaha.	400	
10.	Sasamusa Sugar Works Ld.	... Sasamusa.	650	
11.	The Vishnu Sugar Mills Ld.	... Harkhua.	800	
12.	Shri Krishna Gayanoday Sugar Mills Ld.	... Mirganj.	1400-1500	

Serial No.	Name of Factory.	Location.	Daily cane crushing capacity. (Tons).	Remarks.
NORTH BIHAR (contd).—				
13.	New Savan Sugar and Gur Refining Co. Ld.	... Savan	700	
14.	Indian Sugar Works. ...	... Siwanukhi.	1700	
15.	Bihar Sugar Works. ...	... Pachrukhi.	1000	
16.	Maharajganj Sugar Co. Ld.	... Maharajganj.	300	Not working.
17.	Bharat Sugar Mills Ld.	... Sidhwalia.	600	
18.	Cawnpore Sugar Works Ld.	... Marhowrah.	900	
19.	The Sitalpore Sugar Works	... Sitalpore	900	
20.	The Belsund Sugar Co. Ld.	... Riga.	850	
21.	The Motipur Sugar Factory Ld.	... Motipur.	1200-1300	
22.	The Samastipur Central Sugar Co. Ld.	... Samastipur.	778	
23.	Ryam Sugar Co. Ld. ...	... Ryam.	778	
24.	Lohat Sugar Works. ...	... Lohat.	1300	
25.	Sakri Sugar Works. ...	... Sakri.	700	
26.	The New India Sugar Mills Ld.	... Hasaapur Road.	1000	
SOUTH BIHAR (Bhagalpur, Shahabad, Patna and Gaya).—				
27.	The Ganga Deshi Sugar Factory Ld	... Buxar.	100	Not working.
28.	Mohini Sugar Mills Ltd.	... Bikramganj.	500-600	
29.	Rohtas Industries Ld.	.. Dehri-on-Sone.	1800	
30.	The South Bihar Sugar Mills Ld.	... Bihta.	1300	
31.	Gaya Sugar Mills Ltd.	Guraru.	650	
	BIHAR	...	26856/27406.	
ASSAM.—				
1.	Padmini Sugar Mills	... Deopani	60	Not working.
BENGAL.—				
1.	Sitabganj Sugar Mills Ltd.	... Sitabganj	700	Not working.
2.	North Bengal Sugar Mills Co. Ld.	.... Gopalpur.	1250	
3.	Shree Radha Krishna Sugar Mills Ld.	... Beldanga.	400	
4.	Ramnugger Cane & Sugar Co. Ld.	Plassey.	600	
5.	Carew Co. Ld. ...	... Darsana.	1300	
6.	The Kaliganj Sugar Mills Ld.	... Kaliganj.	150	Not working.
7.	The Deshbandhu Sugar Mills Ld.	Charsindur.	250	Not working.
8.	Dass Sugar Corporation Ld.	... Kishoreganj.	300	
9.	The Rajlakshmi Surgar Mills	... Bhawanipur.	75	
	BENGAL		5225	
N.- W. F. P.—				
1.	The Frontier Sugar Mills and Distillery Ld.	... Takhti Bhai.	400	
PUNJAB.—				
1.	The Gujranwala Sugar Mills Co. Ld.	Rajwali.	300-400	Not working.
2.	The Amritsar Sugar Mills Co. Ld.	Amristar	(Gur only) 42.	Not working.
3.	The Saraswati Sugar Mills	... Abdullapur	450	
4.	The Pattoki Sugar Works	... Pattoki.	100	Not working.
	PUNJAB		... 892-1042	

Serial No.	Name of Factory.	Location.		Daily cane crushing capacity. (Tons.)	Remarks.
SIND.—					
1.	The Pioneer Sind Sugar Co. Ld.	Mohattanagar.		500	Not working.
ORISSA.—					
1.	Aska Sugar Works & Distillery	Aska.		100-120	
2.	Jeypore Sugar Co. Ld. ...	Rayagadh.		150	
	ORISSA.			250-270	
MADRAS.—					
1.	Vizagepattam Sugar and Refinery Ld.	Thummapala.		125	
2.	Etikoppaka Sugar Factory ...	Etikoppaka.		60	
3.	The Shri Rama Sugar Mills Ld.	Bobbili.		150	
4.	The Vuyyuru Co-operative Agricultural Industrial & Credit Society Ld.	Vuyyuru.		850-1000	
5.	The Kirlampudi Sugar Mills Ltd.	Kirlampudi		120	
6.	The Deccan Sugar & Abkari Co. Ld.	Samalkot.	(Gur)	40	
7.	The East India Distilleries & Sugar Factories Ltd.	Nellikuppam		1000	
8.	The India Sugar & Refineries Ltd.	Hospet.		500	
9.	Coimbatore Co-operative Sugar Manufacturing Society Ltd	Podanur.	(Gur)	50	
10.	Al. Vr St Sugar Mills & Distillery	Tachunallur.	(Gur only)	16	
11.	The Sri Ram Sugar Mills Ltd.	Sitanagram.		300	
12.	T. A. Ram-Lakshmi Sugar Mills, Alvartirunagri.	Lakshanatope.	(Gur only)	6	
13.	The Murugappa Sugar Ltd. ...	Mailpatti (Cane)		75	
			(Gur)	10	Not working.
14.	The Southern India Sugar Co. Ltd.	Pugalur		150-300	
	MADRAS			3452-3752	
BOMBAY.—					
1.	The Belapur Co. Ltd. ...	Belapur.		1000	
2.	The Saswad Mali Sugar Factory	Malnagar.		450-500	
3.	The British Maharashtra Sugar Syndicate Ltd. ...	Borgaon.		300-350	
4.	Walchandnagar Industries Ltd. ...	Baramati.		1200	
5.	The Maharashtra Sugar Mills Ltd.	Tilaknagar.		1000-1200	
6.	The Ravalgaon Sugar Farm Ltd.	Ravalgaon.		600	
7.	The Godavary Sugar Mills Ltd. ...	Sakarwadi.		750	
8.	Shree Changideo Sugar Mills ...	Puntamba.		350	
9.	The Somaiya Sugar Factory ...	Lakshmiwadi.		700-750	
10.	The Belvandi Sugar Farm Ltd. ...	Belvandi.		250-300	
	BOMBAY			6600-7000	
	INDIAN STATES.				
KAPURTHALA STATE.—					
1.	The Mahalakshmi Sugar Mills Co. Ltd.	Hamira.		1200-1800	
2.	Jagatjit Sugar Mills Co. Ltd. ...	Phagwara.		750	
RAMPUR STATE.—					
3.	Raza Sugar Co. Ltd. ...	Rampur.		1000	
4.	Buland Sugar Co. Ltd. ...	Rampur.		1000	

NDIAN STATES (*Contd.*)—

Serial No.	Name of Factory.	Location.	Daily cane crushing capacity. (Tons.)	Remarks.
DECCAN STATES.—				
5.	The Kolhapur Sugar Mills	... Kolhapur.	500	
6.	The Ugar Sugar Works Ltd.	... Ugarkhurd.	500	
7.	Krishna Sugar Mills Ltd. (Kudchi)	Miraj Jr. State.	—	
8.	The Phalton Sugar Works Ltd.	... Miraj (Sakharwadi)	625-650	
C. I. STATES.—				
9.	Bhopal State Sugar Industries	... Seohore.	750	
10.	The Jaora Sugar Mills	... Jaora.	450-606	
11.	The Gwalior Sugar Co. Ltd.	... Dabra.	750	
12.	Seth Govindram Sugar Works	... Mahidpur Road.	—	
HYDERABAD STATE.—				
13.	The Nizam Sugar Factory Ltd.	... Bodhan.	1300-1500	
RAJPUTANA.—				
14.	The Mewar Sugar Works Ltd.	... Kareta.	300	
JAMMU & KASHMIR.—				
15.	Shree Yuvraj Jammu Kashmir Sugar Mills Ltd.	... Ranbirsinghpura	—	
MYSORE.—				
16.	Mysore Sugar Co. Ltd.	... Mandya.	1400	
TRAVANCORE.—				
17.	The Travancore Sugar & Chemicals Ltd. ...	... Thauklay.	(Gur only) 18	
	INDIAN STATES ...	...	... 10543-11524	

APPENDIX XIII.

Imports of Sugar Machinery in India.

Whence Imported.	1930-31.	1931-32.	1932-33.	1933-34.	1934-35.	1935-36.	1936-37.	1937-38.	1938-39.	1939-40.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
United Kingdom ...	10,82,836	26,22,991	91,48,018	1,95,87,559	73,60,509	49,70,581	68,49,673	43,64,189	30,16,630	...
Germany	23,238	1,18,670	17,83,649	33,11,442	11,41,661	10,74,103	12,09,318	12,61,132	13,86,501	...
Netherlands... ...	...	...	10,88,971	60,53,605	6,81,545	1,05,324	4,16,189	1,45,260	2,23,122	...
Belgium	...	22,751	31,76,262	34,79,283	18,127	10,735		19,240	15,887	...
France	2,80,323	2,22,297	26,880	39,541	10,30,195	40,114		8,665	11,935	...
Italy	...	...	231	13,444	4,305	10,395		18,851	4,66,594	...
U. S. A.	82,824	27,882	16,324	22,021	70,389	1,13,640		1,87,506	2,40,877	...
Czechoslovakia ...	...	...	68,019	11,13,491	1,83,748	23,229	10,41 282	7,86,129	6,37,478	...
Java	...	...	...	...	32,428	2,20,180		1,72,463	1,34,662	...
Japan	...	...	...	...	20,586	...		9,062	109	...
Other countries ...	...	858	2,772	18,428	1,946	3,201		13,686	3,164	...
Total ...	13,68,716	30,14,449	1,53,11,126	3,36,38,814	1,05,45,439	65,71,502	95,16,462	69,86,183	61,36,959	50,84,254

APPENDIX XIV.

The attached statement shows the quantity of capital goods required for the sugar industry for—

(i) extensions to the existing plants; and

(ii) for 20 new plants.

Only the principal items of machinery have been taken into consideration. The calculations have been based on the policy to be followed in future for the expansion of the sugar industry, *viz.*—

(a) The size for a minimum economic unit is to be raised from 650 tons/day to 800 tons/day. Thus capital goods requirements have been calculated for extensions to plants of 250 tons capacity or above so as to raise their capacities to 800 tons.

(b) For factories of 800 tons capacity or above the milling plants of 14 or 15 rollers are to be extended to plants of 17 or 18 rollers and a second set of knives is to be allowed. This in some cases amounts to an increase it capacity by 10 per cent. and in some cases by 5 per cent. The boiling house is to be balanced for this increased capacity. Capital goods requirements in respect of the above have been calculated.

As the post-war demand of sugar will not be entirely met by the extended plants new factories will have to be put up. Capital goods requirements for 15 new plant have therefore been included in the statement. Items marked with an asterisk relate to the new plants.

As regards goods which will have to be imported from abroad the items marked with double asterisk will have to be imported. The remaining items could be manufactured in India. It may, however, be stated that for juice heaters, evaporators, pans and certrifugals certain component parts such as brass-tubes, calandria plates, steam coils and centrifugal liners will have to be imported from abroad.

Statement showing the quantity of Capital Goods required for extensions to the existing plants of Central Sugar Factories in India in accordance with the proposed policy for extension and for additional 20 New plants (15 Double Sulphitation and 5 Carbonation plants.)

Items of machinery.	For factories below 800 tons per day crushing capacity.	For factories above 800 tons per day crushing capacity.
1. Cane Knives ...	59 sets of Cane knives with engine of 90—100 B.H.	... 20 sets of cane knives with engines of 90—100 B.H.P. 22 ,, ,, ,, ,, ,, ,, ,, 120—125 B.H.P. 6 ,, ,, ,, ,, ,, ,, ,, 150 B.H.P. 15* ,, ,, ,, ,, ,, ,, ,, 90—100 B.H.P. 15* ,, ,, ,, ,, ,, ,, ,, 150 B.H.P.
2. Crushers & Mills** ...	121—3 roller mills or crushers 24″×48″ 3— do 26″×52″ 6— do 27″×54″ 3— do 28″×56″ 4— do 30″×60″	... 10—3 roller mills or crushers 24″×48″ 6—3 do 26″×54″ 10— do 28″×56″ 10— do 30″×60″ 3— do 32″×64″ 2— do 34″×66″ 1— do 35″×78″ 15*—2 roller crushers of 28″×56″ 75*—3 roller mills 28″×56″
3. Juice Heaters ...	47 of 500 sq. ft. H.S. each 50 of 600 do 19 of 700 do	... 9 of 500 sq. ft. H.S. each. 27 of 600—700 sq. ft. H.S. each. 28 of 700—800 ,, ,, ,, 2 of 1000 ,, ,, ,, 65* of 700 ,, ,, ,,
4. Juice Sulphuring tanks ...	68 of 1000 gallons capacity each	... 22 of 1520 gallons capacity each. 14 of 1200 do 5 of 500 do 40* of 1520 gallons each.

Items of machinery.	For factories below 800 tons per day crushing capacity.	For factories above 800 tons per day crushing capacity.
5. Settlers or Dorr Clarifiers.	9 settlers of 1000 gallons. capacity each. 11 do 1200 do 7 do 800 do 8 Dorr Clarifiers 30′ dia. × 3 compts. 7 do 18′ dia. × 4 ,, 1 do 16′ dia. × 3 ,, 7 Additional compartments to existing Dorr of 18′ dia. × 3 compartments.	... 5 Settlers of 1200 gallons capacity each. 5 Dorr Clarifiers of 20′ dia. × 4 compartments. 4 Additional compartments to existing Dorr of 18′ dia. × 3 compartments. 10* Dorr Clarifiers of 20 dia × 3 compartments.
6. Sulphur Furnaces ...	12 of 3 sq. ft. tray area each. 10 of 4 do 5 of 5 do 13 of 6 do	... 2 of 3 sq. ft. tray area each. 2 of 5 sq. ft., etc. 5 of 6 do 3 of 8 do 30* of 5 do 10* of 3 do
7. Air Compressors** ...	15 of 100—150 cu. ft. air displacement per minute. 13 of 200—250 do 3 of 250—300 do	6 of 100—150 cu. ft. air displacement per minute. 7 of 200 do 4 of 300 do 1 of 400 do 20* of 200 do 5* of 150 do
8. Filters ...	52 of 450—500 sq. ft. filtering area each 126 of 600 – 650 do 8 of 700—800 do	... 6 of 500 sq. ft. filtering area each. 97 of 600 - 650 ft. ,, ,, ,, 18 of 700—800 ,, ,, ,, ,, 90* of 650 sq. ,, ,, ,, ,, 55* of 750 ,, ,, ,, ,, ,,

Items of machineny	For factories below 800 tons per day crushing capacity.	For factories above 800 tons per day crushing capacity.
9 Evaporators ...	20 Quadruple effect evaporators of 1200 sq. ft. H.S. each. 6 ,, ,, ,, 8500 do 2 6 ,, ,, ,, 6000 do 3 3 ,, ,, ,, 4500 do 1 2 Tripple ,, ,, 9000 do 2 7 ,, ,, ,, 4500 do 4 4 ,, ,, ,, 3600 do 3 14 Pre-evaporators of 2500—3000 do 8 H.S. each.	3, Quadruple offect evaporators of 14000 sq. ft. H.S. each. Do do 8500 do Do do 6000 do Do do 4500 do Tripple effect do 7500 do Do do 4500 do Pre-evaporators of 4500—5000 sq ft. H.S. each. Do 3500 sq. ft. H.S. each. 15* Quadruple effect evaporators of 14,000 sq. ft. each.
10. Vacuum Pans ...	8 Calandria Vacuum Pans of 1200 sq. ft. H.S. and 25 tons capacity each. 26 do of 1000 sq. ft. H.S. and 22 do 33 do of 850 do and 20 do 6 do of 600 do and 18 do 2 Coil Vacuum Pans 800 sq. ft. H S. and 22 tons capacity. 30 do 600—650 sq. ft. and 20 tons capacity each.	18 Calandria Vac. pans. 1100—1200 sq. ft. H.S. and 25 tons each 16 do 800—900 do 20 do 3 do 1000 do 22 do 3 Coil Pan Vac. pans 850 sq. ft. H.S. each 22 tons do 8 do 600—650 do 20 tons do 45* Calandria Vac. pans 1000 sq. ft. H.S. 25 tons each. 30* Coil Pans 650 do 20 do
11. Injection water Pumps**	13 of 2·5 lakh gallons per hr. capacity each, with high speed engines. 4 of 2·0 do do do 15 of 1·5 do do do 29 of 1·0 do do do	4 of 3·5 lakh gallons. per hr. capacity each. 7 of 2—2·5 ,, ,, ,, ,, ,, 16 of 1·5 ,, ,, ,, ,, ,, 15 of 3 ,, ,, ,, ,, ,,
12. Dry Air Pumps** ...	2 of 1800 cu. ft. Air displacement per mt. each ... 19 of 1000—1200 do do 6 of 800—1000 do do 10 of 500— 600 do do	3 of 2000—2500 c.ft. air displacement per mt. each 1 of 1500 do do do 7 of 1000—1200 do do do 6 of 500—600 do do do 7 of 750 do do do 30* of 1000—1200 do do do

Items of machinery.	For factories below 800 tons per day crushing capacity.	For factories above 800 tons per day crushing capacity.
13. Crystallizers ...	7 of 700 cu. ft. each 92 of 600 cu. ft. each 91 of 500 cu. ft. each	9 of 850 cu. ft. each. 4 of 750 do 46 of 600 do 10 of 500 do 105* of 700 cu. ft. each. 60* of 600 do
14. Centrifugals ...	318 machines of 36″×18″ size 432 machines of 30″×18″ size	30 machines of 42″×20″ 294 ,, ,, 36″×18″ 109 ,, ,, 30″×18″ 480* ,, ,, 36″×18″
15. Boilers** ...	37 of 3000—3500 sq. ft. H.S. each 26 of 4000—4500 do	5 of 5000 sq ft. H.S. each 10 of 4000—4500 sq. ft. H.S. each 4 of 3000—3500 do 60* of 4000 sq. ft. H.S. each
16. Lime Kilns ...	4 of 1000—1200 c.ft. Capacity each 1 of 500 do	4 of 1500 c ft. capacity each 1 of 800 do 5* of 1500 do
17. Gas Pumps** ...	4 of 1200 c.ft. air displacement per mt. 1 of 650 do do	2 of 2000 c ft. air displacement per mt. each 2 of 1500 c.ft. ,, ,, ,, ,, ,, 1 of 1000 c.ft. ,, ,, ,, ,, ,, 2 of 800 c.ft. ,, ,, ,, ,, ,, 5* of 1500 c.ft. ,, ,, ,, ,,
18. Carbonation tanks ...	.....	20* tanks of 300 c ft. capacity each. 5* tanks of 250 ,, ,, ,,

*Denotes machinery required for proposed 20 New Plants of 1000 tons daily crushing capacity (15 Sulphitation and 5 Corbonation Plants.)
**Denotes machinery which has to be imported from abroad.

Items of machinery.	Additional machinery other than shown above required for 20 New Plants of 1000 tons each.
1.	20 *cane carriers* 56″ wide, 120 ft. long between centres.
2.**	20 vertical two *Cylinder coupled steam engines, 8″ dia. × 12″ stroke.*
3.	120 sets of hydraulic attachments.
4.	120 sets of hydraulic accumulators of differential type.
5.	100 slat type intermediate carriers.
6. *	40 low type compound gearings.
7.**	30 horizontal steam engines corliss valve or piston valve type each of 3,50 I.H.P.
8.**	40 duplex type pumps, steam cylinder 12″ dia, pump cylinder 8″ dia. × 12″ stroke.
9.**	150 duplex type pumps, steam cylinder 8″ dia. pump cylinder 6″ dia. × 8″ stroke.
10.**	20 overhead travelling cranes, 12 tons capacity.
11.	20 all steel rake type bagasse elevator 40 ft. long between centres.
12.**	20 automatic juice weighing scales to deal with 12000 gallons. of juice per hour.
13.**	15 duplex-type steam pumps of 7500 gallons per hour capacity.
14.**	15 vertical belt driven double ran milk of lime pumps with rams 3″ dia. × 6″ stroke each.
15.**	40 duplex type s eam pumps (as per item No. 9) but fitted with ball valves.
16.**	120 belt driven geared plunger type molasses pumps.
17.**	40 duplex steam pumps for driving centrifugals.
18.	40 Mugme mixers of 2000 ft. capacity each.
19.	20 screw conveyors.
20.	40 Grass-hoppers.
21.**	40 horizontal belt driven double acting massecuite pumps size 8″ × 10″.
22.	20 boiler house bagasse carriers of the return loop type.
23.**	20 30-H.P. steam engines.
24.**	40 Weir type double acting feed water pumps.
25.**	40 belt driven centrifugal pumps, capacity 20000 gallons per hour.
26.	20 steel chimneys 9 ft. 6 in. dia. × 160 ft. high.
27.**	20 electric lighting plants each consisting of one 50 K.W. generator for 220 volts.
28.**	20 25 K.W. belt driven generator for 220 volts.
29.**	20 workshop crude oil engines of 6 B.H.P. each.
30.**	80 engines of suitable sizes to drive machinery in sections.
	For Carbonation plants (Clarification section only.)
1.**	25 electrically driven centrifugal pumps of 12500 gallons capacity per hour.
2.**	5 steam driven press pumps of 12,500 gallons capacity per hour of the ball valve type.
3.**	5 Pumps of 4,000 gallons capacity per hour.
4.**	5 electrically driven pumps of 4,000 gallons capacity per hour. The dia. of the outlet to be 4″.
5.**	5 Filter cloth washing machines—72″ dia. × 36″ wide.

**Denotes machinery which has to be imported from abroad.

APPENDIX XV.

List of Principal Distilleries Capable of Manufacturing Rectified Spirit.

Province.	Name of Distilleries.	Capacity per month. (B. G. Gallon).
Bihar.	Marhowrah Distillery, Marhowrah.	24,120
Bombay.	The Government Central Distillery, Nasik Road.	78,250
...	Walchandnagar Industries Ltd. Bombay (Kalambh)	40,000*
Bengal.	Russa Distillery, Calcutta.	25,000
	Carew & Co. Ltd., Darsana.	62,500
	Bengal Distillery, Konnagar.	20,620
	United Distillery, Calcutta.	3,120
Madras.	East India Distilleries, Nellikupam.	28,750
	Parry & Co. Ltd., Samalkot.	26,000
Punjab.	Amritsar Distillery Co., Ltd., Khasa.	26,320
	Karnal Distillery Co., Ltd., Karnal.	15,620
	Murree Brewery Ltd., Rawalpindi.	10,000
United Provinces.	Co-operative Distillery, Saharanpur.	18,000
	Standard Refinery and Distillery, Unao.	24,000
	Indian Distillery, Cawnpore.	16,000
	Cawnpore Sugar Works Distillery, Cawnpore.	19,600
	Carey & Co., Ltd., Rosa.	34,400
	Central Distillery and Chemical Works Ltd., Meerut Cantt.	57,000*
	Dyer Meakins Distillery, Lucknow	20,000
	Daurala Distillery and Central Works, Daurala.	49,000*
	Nawabganj.	60,000
	Raja-ka-Sahaspur.	60,000
	Shimbhaoli.	60,000
	Shamli.	60,000
	Captainganj.	60,000
	Hargaon.	60,000
	Golagokarannath.	60,000
Central India.	Cox's Distillery, Nowgong.	24,000
States :—		
Mysore.	Mysore Sugar Works, Maldya, Bangalore.	45,000*
Hyderabad.	Hyderabad Construction Co., Ltd. (Bodhen Distillery, Hyderabad Dn.)	60,000*
Rampur.	Rampur Distillery,	45,000
Travancore.	Parry & Co. Ltd., Nagercoil.	20,000
Baroda.	Alembic Chemical Works.	20,000

* These distilleries are also capable of manufacturing power alcohol.

APPENDIX XVI.

Estimate of Cost of Production of Power Alcohol Prepared by the Aluminium Plant and Vessel Co. Ltd.

UNIT SIZE

BASIS.	2200 galls/day (660000 galls/annum.)			4400 galls/day (1320000 galls/annum).			6600 galls./day (1980000 galls/annum).		
	Quantity	Rate	Total	Quantity	Rate	Total	Quantity	Rate	Total
1. Quantity of Absolute Alcohol produced per hour ...	92 galls.			163 Galls.			275 gallons		
2. Yield of Absolute Alcohol per ton of molasses ...	62 ,,			64 ,,			66 ,,		
3. Molasses required per day based on 2 ...	355 tons			69·2 tons			100 tons		
4. Molasses required per year of 300 days based on 2 ...	10650 tons			20770 tons			30000 tons		
1. Cost of fuel taken at calorific value equal to coal ...		27/- per ton			26-per ton			25-per ton	
2. Steam required per gallon of alcohol produced ...	37 lbs.			36 lbs.			35 lbs.		
3. Fuel required at boiler per gallon of alcohol produced ...	6 lbs.			5 5 lbs			5 lbs.		
1. Sulphuric Acid, cost of		4/- per gall.			3/6 per gall.			3/- per gall.	
2. Ammonium Sulphate, cost of		£11/- per ton			£10/10 per ton			£10 per ton	
1. Capital for plant and buildings complete and started up ...		10 per cent.	£70000			£96.500			£121,500
2. Depreciation on plant taken at, per cent. ...		5 per cent.			10 per cent,			10 per cent.	
3. Depreciation on buildings, etc., per cent. ...		,,			5 ,,			5 ,,	
1. Total capital (including working) ...			£80000			£110,000			£40,000
2. Rate of Interest on Capital ...		5 per cent.			5 per cent.			5 per cent.	

BASIS.		2200 galls/day (660000 galls/annum).			4400 galls/day (1320000 galls./annum).			6600 galls/day (1980000 galls/annum).		
ITEMS		Quantity	Rate	Total	Quantity	Rate	Total	Quantity	Rate	Total
1. Fuel ...	Process expenses.	1770 tons	27/-	£2390	3241 tons	26/-	£4200	4420 tons	25/-	£5,525
2. Acid Sulphuric ...		9000 galls.	4/-	1800	18000 galls.	3/6	3100	27000 galls.	3/-	4,050
3. Ammonium Sulphate		11 tons	£11	121	22 tons	£10/10	200	33 tons	£10	330
4. Labour-General ...				1500			2000			2,250
5. Labour Supervisory and Technical ...				800			1000			1,200
6. Light, Power, Oils, Greases, cleaning materials, etc., etc. ...				200			300			400
7. Upkeep and maintenance ...				200			400			600
8. Entrainer losses ...				150			100			200
9. Depreciation on plant ...	Additional charges.	£50000	10 per cent.	5000	£73000	10 per cent.	7300	£95000	10 per cent.	9,500
10. Depreciation on buildings ...		20000	5 ,,	1000	23000	5 ,,	1100	26000	5 ,,	1,325
11. Depreciation on capitalised royalty at 10 per cent.		800	10 ,,	80	1600	10 ,,	100	2400	10 ,,	240
12. Interest on total capital ...		80000	5 ,,	4000	110000	5 ,,	5500	140000	5 ,,	7,000
13. Insurance, etc. ...				300			500			700
TOTAL ..				£17,541 per year.			£26100			£3,3320
1. Cost per gall. of absolute alcohol if molasses is assumed to be a waste product of no value				6·4*d.* or 5·69 annas			4·75 4·22			4*d.* or 3·56 annas
Cost per gall. of absolute alcohol if molasses be taken at 2 as. per md. (at distillery).		10,650 tons	2 annas	7·35*d.* or 6·53 annas	20,770 tons	2 annas	5·7 5·07	Add 30,000 tons	Total cost 4·95*d.* 2 as.	or 4,40 as.
Do do 4 as. do.			4 annas	8·30*d.* or 7·38 annas		4 annas	6·63 5·89		4 as.	5 85*d.* or 5·20 annas

APPENDIX XVII.

Main Requirements of Equipment for 1,000,000 Gallon Distillery.

1. Conventional Type of Plant.

Basis: Daily troughput of 3300 gallons of alcohol (total) employing a fermentation giving an average wash containing 5% alcohol.

Designs are based on handling 3000 gallons of wash every hour against the theoretical quantity of 2750. Open fermentation vessels would be used and no attempt made to collect or wash Carbon Dioxide, or to recover Yeast.

Anticipated yield 44/45 parts of alcohol by weight per 100 parts of sugar (hexose) used in the distillery.

By employing the " Fourth Technique " distillation plant about 4% of the alcohol made would be recovered as " heads " or low quality spirit suitable for methylation the remainder being absolute alcohol about 99·8% by volume. Oils would be removed and would give a yield of about ¼% on the alcohol.

No allowance is made for storage tanks either for the molasses used as raw material or for the alcohol produced other than the " daily run down tanks ".

It is assumed that tube well water at 85 deg.F. is available for cooling and that this will also be used for making up the molasses wort.

Item.	*Name.*	*Origin.*
1.	Main Molasses Pump and Standby with electric motor	India or Import.
2.	Overhead Molasses Tank. (¼" m.s. plate).	India.
3.	Molassess Controller and Standby with electric motor ...	Import.
4.	Ammonium Sulphate Dissolver 3/8" m.s. lined 10 lb. lead with electric motor	India.
5.	Ammonium Sulphate Overhead Tank. ¼" m.s lined 10 lb lead. ...	India.
6.	Ammonium Sulphate Constant Head Tank. ¼" m.s. lined 10 lb. lead.	India.
7.	Acid Egg, ½" m s.	India.
8.	Acid Stock Tank. ¼"m.s.	India.
9.	Acid Dilution Tank ¼" m s. lined 10 lb. lead	India.
10.	Main Water Tank m.s. sections	India.
11.	Water Constant Head Tank. ¼" m.s.	India.
12.	Wort Balance Tank ¼" m.s.	India.
13.	Molasses Diluter ¼" m.s. plate with electric motor ...	India.
14.	Wort Pumb and Standby with electric motor	Import.
15.	Yeast Machine Tinned copper	India.
16.	Air Compressor	Import.
17.	Open Fermenting Vessels ½" m.s. plate. 12 off @ 12,000 gallons w.c. each.	India.
18.	Main Wort Pump and Standby with electric motor ...	Import.
19.	Open Bub Vessels per %½" m.s. plate 3 off @ 3,000 gallons w.c	India.
20.	Bub Wort Sterilising Tower. Copper and Mild Steel ...	India.
21.	Bub Wort Heat Exchanger. G.M. Copper & C I. ...	Import.
22.	Sludge Vessel ¼" m.s.	India.
23.	Sludge Pump with electric motor	Import.
24.	Main Water Pump and Standby with elec. motor	Import.
25.	Piping & Valves for fermentation system including special controls, etc.	India.
		Raw materials imported.
26.	Fourth Technique Distillation Plant with hot decantation	India.
	(a) Columns, condensers and Decanters in copper ...	Raw materials mainly imported.
	(b) Pumps with electric motors.	Import.
	(c) Piping and Valves	India.
		Raw materials imported
	(d) Special control valves	Import.
27.	Instruments.	Import.

28.	" Daily run down " tanks. 3/16" m.s.			India.
	Process Plant approx,	Steel	130 tons.	...
		Copper	36 tons.	
		Lead	2 tons.	
	Tonnage of Pumps, Compressors, etc. in addition to above		15 tons.	

The cost of the items mentioned above is a little difficult to assess but the following should serve as a rough guide.

Total cost of equipment only erected on site ... ... Rs. 5,30,000.

Of this the majority would be spent in India but the finished items—such as Heat Exchangers, Instruments, Special Valves, Pumps, etc. imported would cost approximately Rs. 1,00,000. This does not include copper sheet, steam valves, etc. normally considered general Engineering Stock. If it is found possible to purchase molasses and some other pumps locally this Rs. 1,00,000 could possibly be reduced by Rs. 20,000.

In addition to the above it would be necessary to provide a *building* which would normally be a steel framed structure with asbestos sheeting. This would probably cost something like Rs 1,30,000 and might involve 100/150 tons of structural steel reinforcing bars, etc.

In most cases also, a separate boiler and generating station would be required as its acquisition would yield a better overall efficiency than taking steam and power from a Sugar Factory except under exceptional circumstances. This would involve a total normal steam capacity of about 1000 lbs. per hour coupled with a generator of about 100 k.w. This would cost about Rs. 1,00,000. The majority of this would have to be spent abroad - say Rs 85,000.

Hence total cost of distillery apart from office accommadation, main storage (for raw materials and product) quarters (if required) sidings or fuel storage etc. Rs. 7,60,000,

It seems reasonable to assume that the total expenditure should not exceed Rs. 9,00,000 to Rs. 10,00,000, it being assumed that sidings, quarters etc. would either be available or be easily obtained as should be the case if the distillery is built on the site of an existing Sugar Factory. Of this Rs. 9 lacs to Rs. 10 lacs not more than about Rs. 1·85 to Rs. 2 lacs being spent on imported units of plant.

The question of Royalties on the Fourth Technique plant is not discussed.

2. Modern Type of Plant.—

Basis: Daily troughput of 3300 gallons alcohol (total) employing a fermentate giving an average wash containing 7/8% alcohol.

Designs are based on handling 2000 gallons of wash every hour against the theoretical quantity of 1840. Closed fermentation vessels would be employed and the Carbon Dioxide washed to recover alcohol. Owing to the type of fermentation used practically no yeast would be produced.

Anticipated minimum yield—48½ parts of alcohol by weight per 100 parts of sugar (hexose) used in the distillery. " Fourth Technique " distillation plant would be employed and 4% of the alcohol would be recovered as " heads " (see above) the remainder being absolute alcohol at about 99·8% by volume. Oils would be separated.

" Daily run down " tanks are included but not the main store tanks.

Tube well water at 85 deg. F. for cooling and wort preparation is assumed.

The whole of the items mentioned under Section I would be required except the following :—

Item 20. Bub Wort Sterilising Tower.

Item 21. Bub Wort Heat Exchanger.

The full wing items would be modified.

Item 17. Fermenting Vessels would be closed and have a total capacity of only 80,000 galls. (w.c) instead of 1,44,000.

Item 19. The Bub vessels would be closed.

The following items would be extra.—

Item.	*Name.*	*Origin.*
(a)	Carbon Dioxide Scrubbing Tower-mild steel and cast iron.	India.
(b)	Carbon Dioxide Blower with electric motor	Import.
(c)	Yeast handling equipment and coolers stainless steel, copper, gunmetal and cast iron.	Import.

Materials needed would be as follows :—

Process plant approximately

Steel	...	110 tons.
Copper	...	32 tons.
Lead	...	2 tons.
Tonnage of pumps Compressors, Instruments, Yeast Machinery imported all in addition to above	...	25 tons.

Total cost of equipment only erected on site	Rs. 5,80 000.
Of this the amount spent abroad would be about Rs. 1,50,000 exclusive of imported copper, etc. as described under Section I. Possible saving on pumps if available in India about	Rs. 30,000.
The building required would be of same type as that described under Section I but appreciably smaller—also approx. (steel say 80/130 tons)	Rs. 1,10,000.
The boiler-generator plant would need to produce about 6000 lbs. of steam per hour and generate about 100 k w. approx. price ... (Of this about Rs. 75 000 would be spent abroad).	Rs. 90,000
Total cost on same basis as section I approximately	Rs. 7,80,000.

It is seen that the total cost is little different from that envisaged for a Conventional plant but the expenditure abroad is about Rs. 2,35,000 instead of Rs. 1,85,000.

The question of Royalties on the Fourth Technique Plant or the Yeast Process is not discussed.

NOTE :—In "modern" process yeast is removed from a finished vessel and used to inoculate a new one. As this speeds up fermentation special methods are required for maintaining correct temperatures.

In the "conventional" process a fermentation vessel cycle of 48 hours will be needed.

APPENDIX XVIII.

Cost of Erection of Food Yeast Plant.

Cost of a 1-ton Installation.—

Basis: A daily troughput of one ton per day of food yeast. Designs are based on the assumption that molasses will contain 50% fermentable sugars and that 60% by weight on the sugar is covered as dry yeast. Hence the daily requirement of molasses will be about 3 tons.

It will be necessary to handle about 400 gallons per hour of fermented wash containing about 2·4% by weight of dry yeast.

No allowance is made for Storage Tanks for the molasses used as raw material.

No allowance is made for godown or for bags for receiving the finished products, but it should be noted that the normal package is a 1 cwt. hessian bag lined with waterproof paper.

It is assumed that cooling water at 85 deg. F. is available. this forming an important item in the plant owing to the fact that the temperature of the fermentation must be strictly controlled.

Description of plant.

A plant capable of producing one ton of food yeast per day would consist of the following items:—

S.S.=stainless steel.

Item No.	*Description.*	*Origin.*
1.	Molasses pump and standby with electric motor ...	Import or India.
2.	Overhead Molasses Tank—¼" m.s. plate	India.
3.	Overhead Water Tank with m.s. sections	India.
4.	Constant Head Water Tank - ¼ m.s.	India.
5.	Molasses Controller with elec. motor	Import.
6.	Molasses Mixer with elec. motor	India.
7.	Wort Preheater in gunmetal and copper	Import.
8.	Steam Injector	Import.
9.	Wort Balance Tank—¼ m.s.	India.
10.	Wort Pump and standby with elec. motor.	Import or India.
11.	Filters in cast iron	India.
12.	Wort Distribution Piping and Regulators s.s. ...	Import.
13.	Three fermenting Vessels 1600 galls. working capacity s s. (s.s. to be imported)	India.
14.	Wort Coolers s s	Import
15.	Circulating Pumps with elec. motor	Import or India.
16.	Air Blowers with elec motors	Import.
17.	Air Filters—m.s. and glass wool	India.
18.	Overflow Tank—s.s. (raw material imported) ...	India.
19.	Five Yeast Separators—s.s. etc.	Import.
20.	Yeast Cream Tank—s s. (raw material imported) ...	India.
21.	Two Yeast Driers with elec. motors.	Import.
22.	Yeast Bogevs (aluminium.)	India.
23.	Chemical Dissolvers s.s (raw material imported) ...	India.
24.	Chemicals Holding Tanks s.s. (—do—)	India.
25.	General Piping (raw materials imported.)	India.
26.	Instruments	Import.
27.	Tubewell Pumps	India.
	Weight of mild steel needed 12/15 tons.	

It is estimated that the total cost of the above plant would be Rs. 3,50,000. This will be made up of equipment Rs. 2,80,000, buildings Rs. 50,000 and erection Rs. 20,000. Of the money spent on equipment, the cost of imported items would be about Rs. 1,50,000 of which it might be possible to save upto Rs.6,000 by purchasing certain pumps etc. locally. The weight of stainless steel which would have to be imported would be approximately 3 tons but the costliest items of all are those concerned with yeast separation and yeast drying.

General Estimates.

It is estimated that for larger plants the following costs would be reasonable:

12 tons per day plant buildings etc.	Rs. 14 00,000
Boiler house and generator if required	Rs. 2,00,000
5 tons per day plant, buildings etc	Rs. 8 00,000
Boiler house and generator if required	Rs. 1,40,000
1 ton per day plant, buildings etc.	Rs. 3,50,000
Boiler house and generator if required	Rs. 60,000

It should be noted that the calculatad eosts of the production of food yeast in plants of the above sizes is as follows. (It being assumed that molasses is available at annas 4 per maund on site).

12	tons	plant	As. 3	—	or allowing	50%	margin	As. 4½	lb.
5	tons	plant	As. 4	—	do	do	do	As. 6	lb.
1	ton	plant	As. 6	—	do	do	do	As. 9	lb.

These figures assume that boiler house and generators are built in with the main plant. If it is desired to purchase steam at about Rs. 5/- per ton and power at about anna 1 per unit the price of the 5 ton plant would rise to 7·5 annas per lb. and for the 1 ton plant 10·5 annas per lb.

All the above figures are calculated assuming costs of raw materials such as caustic, phosphates, etc. as those given in the Special Officer's report for pre-war conditions.

Materials.—

It will be noted that the following ratios of cost exist :—

1 ton plant	... ...	Unity
5 tons plant	... ...	2·32
12 tons plant	... ...	4·06

The material requirements will be roughly in these ratio also. It should be noted that a large plant would normally require some kind of mechanical handling for the finished product, i.e. the dry yeast leaving the driers would be artificially consolidated, raised by a conveyor to a convenient height and delivered to a hopper for filling bags. Mechanical handling of the bags would not be necessary. Such arrangments are included in the price of the 12 ton unit but not in the others.

APPENDIX XIX

Statement showing the proposed location of the Distilleries for the manufacture of Power Alcohol.

1	2	3
Situation of Sugar Factory.	Cane Crushing Capacity Ton/Day	Proposed annual production of Power Alcohol
UNITED PROVINCES		
Group I—Distillery Proposed at Saharanpur.		
1. *Saharanpur* ...	1250	
2. Shamli ...	1400	
3. Lhaksar ...	1100	
4. Doiwala ...	520	10 lac. gallons.
5. Deoband ...	950	
	5220	
Group II—Distillery Proposed at Daurala.		
1. *Daurala* ...	1245	
2. Saknotitanda ...	714	
3. Khatauli ...	1150	10 lac. gallons.
4. Mansurpur ..	1050	
5. Rohanakalan ...	1140	
	5299	
Group III—Distillery Proposed at Simbhaoli.		
1. *Simbhaoli* ...	735	
2. Meerut ...	650	
3. Modi Nagar ...	939	6 lac. gallons.
4. Mohiuddinpur ...	750	
	3074	
Group IV.—Distillery Proposed at Rajakasahaspur		
1. *Rajakasahaspur* ...	1000	
2. Amroha ...	500	
3. Dhampur ...	897	9½ lac. gallons.
4. Seohara ...	1260	
5. Bijnor ...	1058	
	4715	
Group V.—Distillery Proposed at Baheri.		
1. Kashipur ...	650	
2. Kichha ...	750	
3. *Baheri* ...	1279	9 lac. gallons.
4. Bareilly ...	902	
5. Neoli ...	873	
	4454	

1	2	3
Situation of Sugar Factory.	Cane Crushing Capacity Ton/Day.	Proposed Annual Production of Power Alcohol.
UNITED PROVINCES—*contd.*		
Group VI—.Distillery Proposed at Gola or Haragaon		
1. Pilibhit ...	1530	
2. Gola ...	1732	
3. Haragaon ...	1924	13 lac. gallons, both Gola and Haragaon have licences for distilleries at present.
4. Biswan ...	800	
5. Aira ...	650	
	6636	
Group VII.—Distillery Proposed at Hardoi.		
1. Rosa ...	762	10 lac. gallons ; the surplus molasses might be utilised by the existing units at Rosa, Cawnpore Sugar Works, Unao, and Dyer's distilleries which are not likely to consume much in the post war period.
2. Maholi ...	1250	
3. *Hardoi* ...	1565	
4. Bara Banki ...	793	
5. Masodha ...	750	
6. Shahganj ...	751	
7. Jhusi ...	529	
	6400	
Group VIII.—Distillery Proposed at Nawabganj.		
1. Burwal ...	650	
2. Jarwal Road ...	861	9½ lac. gallons.
3. *Nawabganj* ...	1678	
4. Balrampur ...	768	
5. Tulsipur ...	746	
	4703	
Group IX.—Distillery Proposed at Basti.		
1. Barhni ...	822	
2. Pharenda ...	723	
3. Babhnan ...	793	
4. Walterganj ...	760	10 lac. gallons.
5. *Basti* ...	831	
6. Munderwa ...	697	
7. Khalilabad ...	555	
	5176	
Group X.—Distillery Proposed at Captainganj.		
1. Pipraich (2 Factories) ...	1095	
2. *Captainganj* ...	896	
3. Chunghli ...	782	10 lac. gallons.
4. Siswabazar ...	620	
5. Khadda ...	756	
6. Chhaitauni ...	700	
	4849	

1	2	3
Situation of Sugar Factory.	Cane Crushing Capacity Ton/Day.	Proposed Annual Production of Power Alcohol.
UNITED PROVINCES—*contd.*		
Group XI—Distillery Proposed at Sardarnagar.		
1. Lakshmiganj ...	732	
2. Ramkola. (2 Factories) ...	1639	
3. *Padrauna* ..	1046	
4. Kathkuiyan ...	716	
5. *Sardarnagar* ...	2129	
6. Gauribazar ...	838	
7. Baitappur ...	861	19 lac. gallons.
8. Deoria ... (2 Mills) ...	1464	
	9425	
Estimated total Production :—		
UNITED PROVINCES.....116½ lac. gallons.		
BIHAR		
Group I.—Distillery Proposed at Hathua.		
1. *Hathua* ...	1402	
2. Sasamusa ...	761	
3. Harkhua ...	765	
4. Sidhwalia ...	640	
5. Marhowra ...	939	
6. Tankuhi ...	905	
	5412	
Group II.—Distillery Proposed at Pachrukhi.		
1. *Pachrukhi* ...	1114	
2. Maharajganj ...	300	
3. Newsavar ...	919	
4. Indian Savan ...	602	10 lac. gallons.
5. Sitapore ...	746	
6. Bhatni ...	726	
7. Mairwa ...	784	
	5191	
Group III—Distillery Proposed at Narkatiaganj.		
1. *Narkatiaganj* ...	827	
2. Bagaha ...	695	
3. Harinaga ...	1354	
4. Chanpatia ...	885	
5. Majhowli ...	1004	
6. Lauriya ...	602	
	5367	

1	2	3
Situation of Sugar Factory.	Cane Crushing Capacity Ton/Day.	Proposed Annual Production of Power Alcohol.
BIHAR :—*contd.*		
Group IV.—Distillery Proposed at Samastipur.		
1. *Samastipur* ...	764	
2. Hasanpur ...	1010	
3. Ryam ...	736	
4. Sakri ...	673	
5. Lohat ...	1283	
6. Riga ...	961	15 lac. gallons.
7. Sugauli ...	800	
8. Motihari ...	744	
9. Chakia ...	932	
10. Motipur ...	1143	
	8992	
Deduct for Miscellaneous purposes ...	1500	Corresponds to about 5,000 tons of molasses.
	7492	
South Bihar factories may be reserved for supply to Bengal and other miscellaneous purposes. After the erection of Warisaliganj is complete, the establishment of half a million or a million gallon power alcohol distillery in South Bihar according to the surplus of molasses available, may be considered.		
Estimated total production for Bihar.....		45 lac. gallons.
BENGAL		
Distillery Proposed at Darsana.		
1. Gopalpur ...	1250	
2. Beldanga ...	400	
3. Plassey ...	600	
4. *Darsana* ...	1500	7½ lac. gallons.
	3750	
BOMBAY		
Group I.—Distillery Proposed at Maharashtra.		
1. *Maharashtra* ...	1100	
2. Godavari ...	750	6½ lac. gallons.
3. Changdeo ...	350	
4. Somaiya ...	750	
5. Belvandi ...	300	
	3250	

1	2	3
Situation of Sugar Factory.	Cane Crushing Capacity Ton/Day.	Proposed Annual Production of Power Alcohol.
BOMBAY :—*contd*:		
Group II.—Distillery Proposed at Kalamb.		
1. *Kalamb* ...	1200	
2. Saswadmali ...	500	
3. Ugar Khurd ...	500	6 lac. gallons.
4. Phaltan ...	650	
	2850	
MADRAS and ORISSA		
Group I.—Distillery Proposed at Vizagapatam.		
1. Rayaghada ...	150	
2. *Vizagapatam* ...	125	
3. Ettikoppaka ...	60	
4. Bobilli ...	150	4 lac. gallons.
5. Vuyyuru ...	900	
6. Kirlampudi ...	120	
7. Samalkot ...	40	
8. Seethanagram ...	300	
	1845	
Group II.—Distillery Proposed at Nellikuppam.		
1. *Nellikuppam.* ...	2000	4 lac. gallons.

Estimated total production of Power Alcohol *in India*.....189 lac. gallons.

APPENDIX XX

Statement showing the proposed location of mixing depots for the mixing of power alcohol with petrol.

Note. The situation of the Depots is shown in columns (1).
The present average monthly throughout of petrol is shown in columns (2).

Burmah-Shell Depots.		Standard Vacuum Depots.		Caltex Depots.		I. B. P. Depots.	
1	2	1	2	1	2	1	2
1. CALCUTTA AREA							
Budge Budge	15,100	Chittraganj	13,885	Calcutta	155,824	Kalighat	128,492
Kalighat	204,100	Chetla	281,697	Allahabad	4,540	Budge	
Narculdanga	215,800	Fort		Asansol	4,164	Budge	598
Asansol	29,800	Gloster	333	Benares	8,524	Lucknow	16,583
Azamgarh	5,200	Agra	10,722	Gaya	3,605		
Bankura	3,700	Allahabad	13,557				
Benares	21,700	Asansol	14,796				
Berhampore	15,200	Bareilly	13,097				
Bhagalpur	12,800	Benares	10,823				
Bilaspur	3,600	Cawnpore	24,345				
Burdwan	4,100	Cuttack	4,308				
Chakradhar-pur	15,100	Dhanbad	13,201				
Chaibassa	7,900	Gauhati	28,611				
Cuttack	14,800	Gaya	5,422				
Dacca	8,000	Gorakhpur	4,534				
Dhanbad	17,400	Kharagpur	3,943				
Gaya	19,000	Lucknow	14,336				
Giridih	9,200	Ratna	9,989				
Gondia	5,400	Raipur	4,770				
Hazaribagh	10,100	Sarak	6,466				
Jessore	4,500	Siliguri	3,507				
Kharagpur	8,700	Tatanagar	17,282				
Kodarma	2,300	Dum Dum	197				
Mal Junc.	13,700						
Mirzapore	2,400						
Monghyr	3,200						
Muzaffarpur	28,800						
Patna	27,500						
Purulia	4,490						
Raipur	24,100						
Rampurhat	10,400						
Ranchi	22 900						
Raxaul	13,800						
Sambalpur	5,400						
Santahar	18,400						
Seoni	2,800						
Siliguri	24,700						
Tatanagar	29.600						
2 DELHI AREA.							
Agra	31,400	Delhi	73,670	Delhi	67,931		
Aligarh	17,300	Etwah	4,874				
Allahabad	19,400	Hathras	11,167				
Bareilly	21.700	Jodhpur	8,030				
Basti	7,800	Jullundur	21,030				
Cawnpore	30,000	Lahore	63,700				
Delhi	135,800	Multan	36,500				

Burmah-Shell Depots.		Standard Vacuum Depots.		Caltex Depots.		I.B.P. Depots.	
1	2	1	2	1	2	1	2

2. **DELHI AREA.**—*contd.*

Alwar	7,100	Peshawar	64,700		
Etwa	5,700	Rawalpindi	32 800		
Fyzabad	1,900	Saharanpur	19,500		
Gorakhpore	10,900				
Gwalior	10,000				
Jaipur	28,900				
Jhansa	11,100				
Kathgodam	18,000				
Lucknow	30,000				
Meerut	40 900				
Mohaba	6,700				
Moradabad	6,700				
Muttra	8,100				
Muzaffar-nagar	5,500				
Protabgarh	10,400				
Rohtak	17,500				
Satna	6,000				
Shajehanpur	1,100				

3. **KARACHI AREA.**

Karachi	74,000	Karachi	84,000	Karachi	77,041
Morgah	81,200	ex		Agra	3,615
Ambala	12,700	Keamari		Ambala	1,878
Amritsar	24,900	Amballa M.P.I.		Lahore	88,428
Bannu	26,300		27,200	Lucknow	16,902
Batala	6 700	Amritsar	28,800	Rawalpindi	42,257
Chaman	27,000	Sargodha	12 780		
Dehra Dun	16,100	Wazirabad	18,000		
Ferozepur	37,000				
Gujranwala	20,400				
Havelian	15,800				
Hoshiarpur	10,400				
Hyderabad	33,600				
Jammu	38,600				
Jodhpur	20,300				
Jullundur	22,900				
Kalka	10,700				
Karnal	7,100				
Kohat	17,200				
Lahore	100,100				
Larkana	20,100				
Ludhiana	15,700				
Lyallpur	35,600				
Montgomery	33,700				
Moga	11,700				
Multan	34,100				
Nowshera	27 200				
Patiala	13,200				
Pathankote	26,500				
Peshawar	82.100				
Quetta	40,50				
Saharanpur	18,200				
Sargodha	18 500				
Sialkote	15,400				
Tank	8,700				

Burmah-shell Depots.		Standard Vacuum Depots.		Caltex Depots.		I. B. P. Depots.	
1	2	1	2	1	2	1	2
4. BOMBAY AREA.							
Bombay	473,900	Wadala	225,836	Bombay	221,107	Wadala	81,881
Marmugoa	34,500	Ahmednagar	11,768	Ahmedabad	28,096		
Ratnagiri	9,900	Akola	10,315	Nagpur	21,081		
Karwar	3,600	Amraoti	11,352	Poona	46,953		
Chipleon	8,300	Asarwa	45,180	Rutlam	752		
Coondapur	1,300	Baroda	9,446	Secundera-bad	14,777		
Kumta	4,100	Belgaum	13,982	Sholapur	6,355		
Ahmednagar	19,400	Bhopal	7,258				
Akola	16,000	Dhulia	3,888				
Amraoti	16,200	Hubli	18,122				
Bhopal	13,400	Jalgaon	3,834				
Dhulia	11,600	Jhansi	7,684				
Dhamangaon	8,100	Jubbulpore	11,778				
Gulberga	5,300	Kolhapur	17,449				
Jalgaon	17,200	Manmad	...				
Jubbulpore	18,200	Marmugoa	5,975				
Khamgaon	12,600	Nadiad	9,111				
Khandwa	12,400	Nagpur	23,772				
Karjet	8,800	Nasik Rd.	22,439				
Manmad	16,600	Poona	43,923				
Aurangabad	4,600	Rutlam	7,216				
Jalna	1,600	Satara	15,384				
Murtizapur	4,300	Secunderbbad	46,417				
Nagpur	36,800	Shimoga	6,474				
Nasik	30,000	Sholapur	3,220				
Poona	97,100	Surat	8,811				
Belgaum	80,300	Udipi	7,533				
Dharwar	8,200						
Gadag	11,400						
Hubli	18,100						
Kolhapur	40,500						
Lonand	13,100						
Sangli	22,800						
Satara	17,000						
Sholapur	24,700						
Bagalkot	6,700						
Bijapur	9,100						
Wardha	5,100						
Baroda	35,200						
Broach	3,400						
Nadiad	15,300						
Navsari	6,300						
Rutlam	23,000						
Indore	37,100						
Surat	28,300						
Ujjain	5,700						
Kotah	9,500						
Saugor	9,100						
Godhra	5,200						
Okha	16,900						
Morvi	17,500						
Ahmedabad	117,900						
Ajmer	22,200						
Udaipur	5,800						
Bellary	11,200						
Birur	8,300						
Chitaldroog	6,400						
Hassan	9,300						
Shimoga	15,600						

Burmah-Shell Depots		Standard Vaccum Depots		Caltex Depots		I. B. P. Depots	
1	2	1	2	1	2	1	2

5. MADRAS AREA.

Tondiarpet	43 300	Madras	99,9:0	Madras	89,264		
Cocanada	13,100	Bangalore	53,750	Bangalore	14,708		
Ernakulam	34,700	Bezwada	22,732	Guntakal	3,904		
Bangalore	122,600	Bellary	5,757	Trichino-poly.	11,743		
Bezwada	34 300	Calicut	16,178				
Bowringpet	15,200	Coimbatore	10,419				
Calicut	24,600	Cuddapah	11,835				
Chicacole Road.	4,900	Dinigul	14,630				
		Guntur	9,782				
Coimbatore	28,400	Karaikudi	14,776				
Cuddalore	14,800	Katpadi	21,196				
Cuddapah	22,900	Madura	27,862				
Dindigul	12,900	Mangalore	8,990				
Erode	11,300	Mettupalayam	19,015				
Guntur	28,700	Mysore	15,783				
Karaikudi	16,100	Pudukottah	16,773				
Katpadi	54,600	Salem	21,550				
Kottayam	33,900	Tindivanam	1,198				
Kumbakonam	14,900	Tinnevelly	8,604				
Kurnool	7,100	Trichino-poly.	30,475				
Madura	35,000						
Mangalore	27,500						
Mayavaram	5,200						
Mettupalayam	36,900						
Mysore	22,000						
Nandyal	1,800						
Nellore	28,900						
Nidadavole	13,400						
Nizamabad	5,300						
Nuzvid	17,100						
Ootacamund	3,400						
Palghat	46,200						
Pollachi	22,300						
Pudukottah	10,300						
Quilon	159,300						
Raichur	3,700						
Rajahmundry	9,200						
Salem	31,400						
Salur	9,800						
Sattur	18,300						
Secundera-bad.	123,900						
Tadepalli-gudem.	3,300						
Tanjore	9,400						
Tellicherry	30,500						
Tindivanam	10,200						
Tinnevelly	19,700						
Tiruppur	14,500						
Tiruvanna-malai	6,200						
Tiruvarur	8,200						
Trichinopoly	20,200						
Trichur	24,600						
Trivandrum	28,900						
Tuticorin	6,600						
Vizianagram	8,100						
Waltair	20,300						
Warangal	9,300						
Wellington	17,700						

APPENDIX XXI

Alcohol as motor fuel : Technical considerations.

It has been established long ago that alcohol either neat or mixed with petrol, could be used as fuel for internal combustion engines. The chief drawbacks against its use are that alcohol has lower vapour pressure, lower calorific value and higher specific gravity as compared with petrol. It is also hygroscopic in character and therefore absorbs moisture from the air.

2. For the use of alcohol, unmixed with petrol, drastic alterations to the carburettor system are necessary, and alcohol cannot be used as an alternative fuel to petrol for the same engine without extensive adjustments. Owing to the lower air to fuel ratio necessary for satisfatory engine operation when using neat alcohols as compared with operation on petrol and also the lower calorific value of alcohol, satisfactory acceleration, power output, general running and fuel economy can only be attained by increasing the sizes of the carburettor jets to sizes up to approximately 1·5 times larger than those used in the case of petrol At the same time, owing to the difference in specific gravities the carburettor float requires to be proportionately weighed to maintain the fuel level at the jets. The lower vapour pressure of alcohol leads to difficulties regarding starting of the engine from cold. Improvement in this respect would require the fitting of heating devices to the carburettor and induction manifold. Engines running on alcohol unmixed with petrol, in order to be efficient, must employ higher compression. Such engines have to be specially designed If the carburettor system of a commercial motor engine of the usual type is altered to make it suitable for use with alcohol, it would not be able to run on petrol without inconvenient readjustments of its carburettor. Thus, it is only possible to run on alcohol fuel, when the user is sure of getting continuous supply of the material. Such conditions would apply to a user whose service is within a limited radius of the supply base, for instance, local suburban bus services etc. The above is true whether power alcohol is used or rectified spirit.

3. A characteristic of rectified spirit is that whilst it is capable of remaining as a mixture when mixed with 50 per cent petrol or less, it is liable to separate out when the amount of petrol exceeds 50 per cent. In any mixture consisting of 50 per cent. rectified spirit or more with petrol the conditions mentioned in the paragraph above for unmixed alcohol apply, but only to a limited extent. It may be poesible to run the engine with out a special heating device and the jet enlargement of the carburettor need not be as large as in the case of unmixed alcohol. The alteration in the flow level need not also be so great Thus, it would be possible to run the same engine on straight petrol without adjustments, although petrol consumption would be higher than when the carburettor was properly abjusted for petrol. It is possible, therefore, to employ 50/50 mixture of alcohol and petrol without appreciable inconvenience so long as there is a reasonable certainty of obtaining the fuel. This can be assured by arranging the marketing of a certain amount of 50/50 fuel in a certain district or area.

4. The great advantage of power alcohol is that it is fully mixable with petrol up to a mixture of 25 per cent. alcohol and 75 per cent. petrol. For such mixtures, containing up to 20 per cent. of alcohol, there is no difference in behaviour with that of neat petrol. No carburettor adjustments are required and a motor vehicle can, therefore, run indiscriminately on neat petrol or this mixture. In a mixture of 20 per cent absolute alcohol and 80 per cent petrol, the higher latent heat of alcohol becomes an important factor. Although alcohol has lower calorific value, the effectiveness of a mixture of 20 per cent. alcohol and 80 per cent. petrol is the same as that of ordinary petrol and the consumption of the mixed fuel per gallon is also practically the same.

5. A 20 per cent. power alcohol and 80 per cent. petrol mixture does not show any tendency for seperation of alcohol and petrol at temperatures such as are likely to be met with in this country. Also, there is no danger whatsoever of such a mixture separating out on account of absorption of water by alcohol owing to the hygroscopic property of the latter.

APPENDIX XXII.

Summary of Report of the Power Alcohol Committee of the Inquiry, Australia, 1941

Introduction.—

For strategic reasons, and in view of the possible depletion of petroleum resources, there is world-wide interest in such substitute fuels as petrol from coal and shale, power alcohol, benzol, charcoal, producer gas and coal gas.

Anhydrous ethyl alcohol may be manufactured from sugary, starchy or cellulosic materials. As power alcohol it is most commonly used in 12½ per cent. to 20 per cent. blends with petrol.

Power Alcohol Production in other Countries.—

The world production of power alcohol approximates to 200,000,000 gallons, distributed among some dozen countries. In most countries, where power alcohol is used, there is legislation to enforce its use; this is necessary owing to the higher price of alcohol than of petrol.

Power Alcohol Production in Australia.—

Anhydrous alcohol for use as a motor fuel has been produced in Australia since 1925, though it is only recently that the total annual production has exceeded 1,000,000 gallons. The use of power alcohol has been covered by State legislation in Queensland (1933), and in New South Wales (1941).

The total present normal capacity of distilleries engaged in the power alcohol industry is 5,000,000 gallons per annum. Owing to shortage of raw materia. (molasses) the distilleries have not worked hitherto to full capacity. It is estimated that there is, in addition, suitable distillery capacity in Australia for some 5,000,000 gallons of 95 per cent. alcohol.

Methods of Production.—

The process of manufacturing anhydrous alcohol from sugary substances comprises (a) fermentation by yeast to produce a liquid containing 10 per cent alcohol and (b) distillation of the fermented liquor and dehydration by a patented process.

Starchy substances must first be treated by malting, hydrolysis with acid, or the action of moulds (amylo process) to break the starch down to sugar. Subsequent fermentation and distillation are much the same as for sugary substances.

Cellulosic substances (*e. g.*, wood) may be converted to sugar by two processes, both involving the action of acid on wood.

General by-Products.—

There is no immediate prospect of an additional financial return from the recovery of the by products common to all fermentation processes carbon dioxide, fuel oil, and yeast.

Value as Motor Fuel.—

Alcohol containing water is unsatisfactory as a motor fuel unless considerable quantities of a blending agent are added. Discussion in the Report is based on the use of anhydrous alcohol in 12½ to 20 per cent. blends with petrol.

There is ample evidence that alcohol-petrol blends in the proportions named possess all the properties desirable in a motor fuel. Evidence indicates that there is no measurable difference as between a 15 per cent. alcohol-petrol blend and other super fuels in mileage per gallon, and in other criteria of performance

The addition of 1 per cent. of alcohol to petrol raises the octane rating by about 0·6 unit A higher octane rating over that of standard grade petrol is desirable for many modern cars and is likely to increase in importance as engine design changes.

Before the war, super-grade (75-78 octane) fuels in Australia were obtained by :

(a) importing high octane petrol ;

(b) adding tetra-ethyl-lead to standard grade (70 octane) petrols ;

(c) adding anhydrous alcohol to standard grade petrol.

Government measures since the war began have excluded the first two methods.

Alcohol may be assigned on "additive value" in excess of the value of an equal volume of petrol, by reason of its power to raise a standard grade fuel to a "super" grade, when blended in the correct proportions. The level of this "additive value" depends upon the assumptions on which the calculation is made, and can range from 2d. to 7½d. per gallon alcohol.

Transport.—

Technical difficulties in the transport of alcohol in drums or in road or rail tanks have been overcome.

There is no experience of the transport of large quantities of anhydrous alcohol in tanker ships. The chief technical difficulty is to avoid absorption of water; this difficulty would have to be overcome before alcohol could be successfully transported by sea in bulk.

Estimates were prepared for the Committee, of the cost of transporting alcohol from Queensland ports to Sydney and Melbourne in a 1,300-ton vessel designed to carry 420,000 gallons. The estimate of transport costs for 6,000,000 gallons per annum amounts to 2·39*d.* per gallon, exclusive of delivery to and from the ship; an estimate of the total transport cost from a Queensland distillery 20 miles in and, to blenders depots in Melbourne and Sydney, amounts to 3½*d.* per gallon.

Denaturation.—

Power alcohol may be denatured as for mineralized spirits, *i. e.*, by adding ½ per cent. methyl alcohol, 1/20 per cent. pyridine and 2 per cent. petrol. A more suitable denaturation, for use only under security to the Customs Department, is¼ per cent. methyl alcohol and 5 per cent. petrol.

The present cost of denaturing power alcohol is between 0·4d. and 0·8*d* per gallon, according to locality.

Royalties.—

Royalties at rates of about ½*d.* per gallon are payable on patents covering the process of producing anhydrous alcohol.

Sugar.—

A brief review is given of the history of the sugar industry in so far as it bears on the Terms of Refereuce of the Committee. From a survey of the present position of the industry in Queensland it is concluded that (a) the average price of cane as sold to the mill-owner is about 32s. per ton; (b) the home consumption price of raw sugar is approximately £23·10s. per ton; and (c) the export price has varied from about £8 per ton pre-war to about £11 per ton at present. The average price of home consumption and export sugar together is about £15 10s. per ton. The present positions in New South Wales for sugar-cane and in Victoria for sugar beet are described.

In 1940, over 50 per cent. of Queensland molasses was sold to distilleries; this percentage is expected to rise to approximately 75 per cent. in 1941. The usual price is 15s per ton at mill. Only a negligible quantity of molasses is run to waste. Whatever be done, no further significant increase in power alcohol production from molasses can be expected.

In the process of milling, sugar-cane is crushed to produce a juice which is clarified. In a series of four stages the clarified juice is crystallized, and the sugar crystals are separated from there corresponding syrups by centrifuging. After the last crystallisation there remains the molasses.

After examining several schemes whereby sugar might be diverted during manufacture to supply a raw material for alcohol production, the Committee considers that a "juice mill" scheme would be more satisfactory than the other schemes it examined. In this scheme a distillery operates on clarified juice from some 250,000 tons of cane being the entire crop consumption at one large mill. If it were agreed that a price of £7·9s. at mill per ton of 94 net titre sugar and corresponding molasses, both in the form of clarified juice were so be paid (approximately equivalent to about £9 per ton 94 net titre sugar f. o. b. Queensland port) then the alcohol could be sold in capital city at 2s. per gallon wholesale.

Each 1,000 000 gallons of alcohol produced from sugar-cane would absorb about 50,000 tons of cane, or 8,000 tons of sugar.

Wheat —

A review of the position of the wheat industry leads to the conclusion that after the present year (1941), there will be difficulty in disposing of Australia's war-time surplus of wheat.

The average price per bushel f. o. r. Williamstown (Victoria) over the years 1921—1939 is 3s. 2d. The view was expressed that the lowest price likely to be accepted for wheat as a raw material for alcohol in 3s.6d. per bushel f o r., this corresponds to a price for alcohol of about 2s. per gallon by the malting process. According to the 1935 Royal Commission, a price of 3s. 6d. a bushel would return costs to only about half the wheat farmers of Australia. On the present fixed return to growers of 3s. 10½d. f.o.r. port, the price of alcohol would be approximately 2s. per gallon by the amylo process. Of the two processes, malting is the better known.

In these estimates, allowance for revenue from by-products has been made only for the value of fodder.

Each 1 000,000 gallons of alcohol, produced by the malting process would absorb about 485,000 bushels of wheat.

Unless some pooling system for the selling of wheat persists after the war, or unless an arrangement is made by the Government for the purchase of wheat for alcohol production, there can be no assured supply of wheat in adequate quantity and at a stable price.

Wood.—

Tasmanian proposals for the production of alcohol from wood were examined. The process of converting wood into alcohol has not been carried out in Australia, even on an experimental scale. Consequently little confidence can be placed in present estimates of the cost. Tentative estimates point to a likely cost of about 2s. per gallon of alcohol.

Wood is probably the cheapest potential raw material for alcohol in Australia. With proper management, forests could be used for this purpose without their becoming exhausted.

Much time would be required and expense involved before the most suitable process (the Scholler process) could be successfully applied in Australia. The Committee recommends that research should be undertaken into the technology of the process.

Other materials.—

Apples and Pears.—Owing to the loss of overseas markets, there is likely to be annual war-time surplus of some 65,000 tons of apples and 11,000 tons of pears; these together are a potential source of some 975,000 gallons of alcohol.

Apples and pears are unsuitable as raw materials for alcohol because (a) their cost would be too high even at the lowest possible price (40s. per ton including collection costs, equivalent to 8s. per gallon of alcohol for raw material only); (b) they are perishable; and (c) the apple and pear surplus is widely dispersed, in places many of which are remote from distilleries.

Grapes.—Owing to war-time loss of overseas markets, there are prospects of an annual surplus of some 40,000 tons of grapes; this is a potential source of some 800,000 gallons of alcohol.

The cost of alcohol from grapes would exceed 6s. per gallon if a fair price (£4 17s.6d per ton) were paid for grapes.

It has been suggested that the bounty of £200,000 formerly payable on export wine should be transferred to the anhydrous alcohol which could be made from that wine. If this transfer were made, the bounty, together with the return from sales of alcohol at present market prices, would approximately balance the cost of production of the alcohol. The amount of alcohol so produced would be small, but the grape industry might thus be maintained until overseas markets were restored.

Root Crops.—(Sugar beet, potatoes, sweet potatoes, Jerusalam artichokes, yams). There is no regular surplus of any of these crops in Australia. In respect of cost, none of them compares favourably with sugar or wheat as a source of alcohol.

Maize.—There is no regular surplus of maize in Australia. At a fair average price for maize (5s. a bushel) the cost of alcohol would be not less than 8s. 6d. per gallon.

Sorghum.—The production of sorghum is limited, and there are not reliable estimates as to the cost. If sorghum were grown extensively it might compare favourable with wheat and sugar as a source of power alcohol, and some investigation of its possibilities is advisable.

Other Cereals.—There may be an unexportable surplus of barley during the war. There is no regular surplus of oats. Both these cereals deserve consideration as alternatives to wheat.

Tropical Crops.—The crops in Australian tropical Territories which might provide raw material for power alcohol are nipa palm, sago palm and cassava.

Nipa Palm, Sago and Cassava.—In Papua and New Guinea there are areas of nipa palm and sago large enough to supply raw material for the production of considerable quantities of alcohol. With proper control and cultivation these areas could be exploited without risk of the raw material becoming exhausted. Cassava is not at present a widespread crop, but it could be grown satisfactorily in New Guinea and Papua and ossibly in Northern Queensland.

There are no reliable data as to the costs of production of raw material and distillation in the Australian Territories, and transport of alcohol and of raw material to Australia. Tentative estimates indicated the following general level of costs:— (a) the cost of producing alcohol from nipa palm in Malaya, up to 1932, was about 3s. per gallon (Australian); alcohol production on a large scale might cost less in Papua, but not less than alcohol from wheat or sugar; (b) alcohol from sago or cassava grown in New Guinea would probably cost in the region of 2s. per gallon if the raw material were converted in the Territory and the alcohol shipped to Australia. These estimates indicate no more than the need for further investigation.

The contentions that power alcohol production would supply the Commonwealth with an indigenous supply of fuel in case of a blockade and would contribute to the stabilization of agriculture are greatly weakened in respect of power alcohol produced from Papuan or New Guinea crops.

General financial and economic consideration.—

In order to assess the economic consequences of a power alcohol industry, it is necessary to weigh the extra costs against the national and social benefits of the industry.

Australia's normal peace-time requirements of motor fuel are, at a minimum, 350,000,000 gallons. If all this were to be a 15 per cent. alcohol blend, the nation's requirements of alcohol would be 52,500,000 gallons.

The extra cost to the community of replacing 52,000,000 gallons of petrol by alcohol is estimated by adding the loss of revenue from duty payable on this quantity of petrol to the extra cost of alcohol over that of duty-paid petrol. Examples are given assuming two costs of petrol and two levels of customs and primage It is shown that, assuming the wholesale price of alcohol is 2s. per gallon, the total extra cost of producing 52,000,000 gallons of alcohol would, under present conditions, be £3,142,000. Spread over the cost of motor fuel to the community as a whole, this sum amounts to an increase of 2.15d. in the price of a gallon of fuel. The sum of 2.15d. is reduced to 1.65d. after allowance is made for the value received from the use of alcohol blend as a super fuel. A similar set of calculations is made for pre-war conditions. The duty-free cost of the petrol replaced would be £2,054,000.

Against this cost must be set —

(a) the strategic value of an indigenous supply of fuel, expansion of the power alcohol industry would be the quickest way to meet the need for the local production of some proportion of Australia's liquid fuel requirements;

(b) a contribution to the stabilization of agriculture; expansion of the power alcohol Industry would provide a new outlet for crops which owing to the war or for other causes, may for some time to come have an unmarketable surplus. If a new outlet be not found for this crop surplus it will become a charge on the community in some other way.

The extra cost of power alcohol is higher than that usually prevailing in "normal protected industry." Nevertheless, alcohol has been sold at 1s.11d. per gallon for blending with petrol costing only 1s.½d., without enforcement by legislation, and the blend has been sold on the open market as a super grade fuel.

New distilleries —

Factors affecting a decision on the sites for new distilleries are strategic considerations; capacity of the State to absorb power alcohol; quantities of wheat and sugar in excess of home consumption; and speed with which distilleries could be erected.

Distribution of new distillery capacity is given on the basis of states requirements of alcohol in relation to petrol consumption; a distribution between wheat and sugar, based on using equal percentages of exportable quantities of these materials, is also given.

While a decision as to the location of distilleries would be a matter for the Government, a tentative distribution of distillery capacity between States is set out for purposes of illustration.

Constructional labour and equipment.—

Unforeseen problems are not likely to arise in the design and fabrication of distilleries for sugar products, or for wheat using the malting process. The building of distilleries to operate on wheat by the amylo process presents certain difficulties. There is at present insufficient experience in Australia for the design and operation of a distillery to make alcohol from wood.

If the work be placed sufficiently high in the defence priority list, a single juice mill distillery of 5,000,000 gallons annual capacity could be completed in from 12 to 18 months, and a wheat distillery of the same size in 24 months.

The number of men and quantity of material required in the design, fabrication and erection of one 5,000,000 gallons distillery, costing about £500 000 are given.

Organization and control production.—

In order to ensure financial stability to a permanent power alcohol industry, it may prove necessary for the Government to guarantee both capital and profits; an alternative would be joint investment of capital by Commonwealth and/or State Government, and private interests.

Governmental control of production would be assured by either of the above methods. Control of production could alternatively be exercised by State Government prohibiting the erection of distilleries in their territories except under licence.

If new distilleries be erected by the Government as a war-time emergency measure, they should be operated for a period of 5 years, and their future then determined in the light of conditions then ruling.

To facilitate that decision, the Government should institute enquiries into several matters set out.

Marketing.—

Some legislative control is necessary for the successful marketing of power alcohol, to ensure :—

(a) the sale of all alcohol of which the selling price is reasonable ;

(b) that the benefits of alcohol as a blend with petrol are not lost by the use of unsuitable proportions of alcohol in the blend ;

(c) that alcohol-petrol blends of suitable quality are sold under distinctive names as super fuel.

During the war, regulations under the National Security Act 1939-40 would ensure the marketing of suitable blends. After the war, marketing could be controlled either by State legislation (as in Queensland at present and as proposed in New South Wales) or under the Customs Act 1901-1936.

Matters requiring further investigation.

Any permanent development of the power alcohol industry should be accompanied by technical research, examples of which are given; the type of organization necessary to conduct such investigations is outlined.

Conclusions.—

The Committee considers it established that anhydrous alcohol *is* entirely satisfactory as a motor fuel when blended with petrol in proportions between 12½ pert cent. and 20 per cent. Alcohol, to be used for blending, has a value in excess of the value of an equal volume of standard petrol, by reason of its power to raise a standard grade fuel to super grade. Maximum benefits are obtained with 15 per cent. of alcohol, and the Committee considers that alcohol should be blended in this percentage, and the blend marketed through the established channels for petrol distribution under distinctive name indicating the presene of alcohol. The norma consumption of petrol in Australia is about 350,000.000 gallons per annum ; if this quantity were in the form of a 15 per cent. alcohol blend, 52,500.000 gallons of alcohol would be required.

The three existing power alcohol distilleries in Australia, if operating continuously and using raw sugar to supplement their raw material, molasses. could produce about 7,000.000 gallons of power alcohol. On this basis, Australia could absorb production from new distilleries of a total annual capacity of 45,500,000 gallons of anhydrous alcohol. Production could be brought to this level by building new distilleries suitably distriuted through the Commonwealth. The Committee makes no recommendation as to the distribution of distilleries between wheat and sugar; one possible distribution discussed in the Report is 38.000.000 gallons from wheat and 7,500,000 gallons from sugar By this distribution each State except Tasmania, which has no suitable raw material, would produce 15 to 20 per cent. of its liquid fuel requirements. and the industry could use about 15 per cent of the normal exportable quantities of wheat and sugar. If placed sufficiently high in the defence priority list for supply of material and skilled tradesmen, all the distilleries could be completed in about two years. For one distillery of 5,000,000 gallons annual capacity, about 150 tons of copper and 1,500 tons of iron and steel would be required; also some 160 skilled tradesmen and about 150 unskilled workmen.

The Committee has been unable to discover any raw materials, other than molasses, which would permit the production of power alcohol at wholesale selling prices below 2s. per gallon in capital cities. Raw materials from which alcohol could be made and sold at this price are :—

(i) Sugar, provided that a large distillery is built adjacent to an existing raw sugar mill from which clarified cane juice is obtained, and that the sugar is purchased at a price equivalent to £9 per ton for 94 net titre sugar f.o.b. Queensland ports ;(ii) wheat, provided that large distilleries are built in favourable localities and that wheat is available to these distilleries at a price of 3s 6d. or 3s.10½d. (depending on the process used) per bushel f.o.r. shipping ports.

Alcohol could also be produced from grapes at 2s. per gallon, but only if production were subsidized from the amunt of£2, 00, 000, per annum previously paid as a bounty on exported wine (about 4s 6d.per gallon of power alcohol was suggested). Since the production from grapes would be only some 800, 000 gallons per annum, it would be of little interest from the standpoint of motor fuel supplies. The main value of the proposal lies in the stability it offers to the grape industry during the war, but the committee does not consider it necessary to do more than draw the attention of the Government to the proposal.

The cost of construction of a distillery of 5, 000, CC0 gallons annual capacity would be in the neighbourhood of £5, 00, 000, so that amount required for an annual production of 45. 000, 000 gallons would be about 4,500,000 working capital to be provided in addition to this would depend on the system of trading adopted, but need not amount to a large sum. The manufacturing cost, including interest on capital but excluding cost of raw materials and transport, is estimated to vary from 7d. to 9d. per gallon, according to the type of distillery and raw materials. To this must be added the cost of transporting either the raw material or the finished product. The sum of these costs together with raw material costs equivalent to about£9 per ton 94 net titre sugar f.o.b. Queensland ports or 3s. 6d (malting process) to 3s. 10½d. (amylo process) per bushel for wheat for shipping ports, will result in alcohol at 2s. per gallon. The committee suggests that this price should be the maximum selling price of power alcohol, wholesale in capital cities. In both cases these prices for sugar and wheat are close to export prices.

Replacing petrol by 52, 000, 000 gallons of alcohol at 2s. per gallon, wholesale in capital city, would cost the Australian Community, at present prices, a total of £31, 42,000 of which£24, 70, 000 is Government revenue. Spread over the annual petrol consumption (350,000,000 gallons)the total extra cost corresponds to 2. 15d. per gallon, made up of 1.69 d. for Government revenue and 0. 46d. for extra cost of alcohol. Since the alcohol-petrol blend is a super grade and some 50 per cent. of consumers are willing to pay 1d. , per gallon more for this, the sum of 2. 15d. is reduced to 1. 65d. when allowance made for the value received. At pre-war prices, the extra costs are higher.

Although the cost of power alcohol is considerably higher than that of imported petrols, there are important national and social advantages to offset this. Two main benefits which must be weighed against the extra cost are (i) defence value, and (ii) stabilization of agriculture. At the present time the defence value is paramount and on this aspect alone it seems justifiable to expand productions. In addition, the stabilizing effect of the industry on agriculture by providing a home market for some proportion of the unexportable wheat and sugar, is considered important enough to justify considerable expansion of the alcohol industry. There is no intention that encouragement should be given to the production of wheat and sugar above present levels to order to supply material for power alcohol ; on the contrary the raw material for this expanded industry should come from present production unable to be exported. Unless this is done, stabilization will not be effected.

Producers of wheat and sugar would hesitate to enter into the necessary long-term contracts to supply their products at the prices mentioned. This uncertainty in contracts for raw materials, together with the rate of interest on capital taken in the cost estimates, would not make the proposal attractive from the point of view of private investment. Furthermore, private investors would obviously not support a project for the establishment of factories to operate for a short time only. For these and other reasons, it is suggested that either the capital should be provided by the Government, or there should be a combination of Government support and private investment ; constructions and operation of the plants should be delegated to companies experienced in the industry. In both these cases, means af preventing undue expansion in the industry would be in the hands of the Government.

The Committee considers that, if the erection of distilleries is undertaken at once, it should be on the basis of operation for five years from the beginning of production, and the position should then be reviewed. A decision, based on the state of affairs at that time, could then be made as to the future of the industry. Since power alcohol production would be under Government control, the policy then to be followed would clearly lie in the Government's own hands.

In an Interim Report, submitted on 28th march, 1941, the Committee recommended that the Government should take immediate action (i) bring the production of the three existing power alcohol distilleries up to full capacity by using raw sugar; (ii) to investigate the production and use of 95% alcohol as a motor fuel. The point of the second recommendation is that there are many small distilleries scattered throughout Australia capable of producing 96% alcohol. Although this is not nearly as suitable as anhydrous alcohol for use as a motor fuel, its production and use in an emergency is worth consideration.

Finally, it is necessary to enumerate the reasons behind the Committee's decision to recommend an immediate large expansion of the power alcohol industry, despite the high cost of alcohol as a liquid fuel. The reasons are as follows :—

(a) there is an immediate and urgent need for greater quantities of indigenous liquid fuel than are produced at present ;
(b) there is need for some new outlet for surplus and unmarketable crops (in particular wheat and sugar) until normal trade relations are resumed ;
(c) the Committee assumes that the Government has not, at present, any more satisfactory way of meeting these two needs ;
(d) the Committee considers that the Government should, owing to the great importance of liquid fuel in the defence and economy of Australia, be prepared to face the costs to the community that might follow the adoption of the committee's recommendations. The recommendations are made with the knowledge that owing to changed conditions, the expanded industry might eventually have to be curtailed ;
(e) the Committee wishes to record that the information put before it is sufficient to support the recommendations.

Recommendations.—

The Committee makes the following recommendations :—

I. Immediate action should be taken to erect distilleries to produce 40,500,000 gallons of anhydrous alcohol per annum. If 95% alcohol should prove unsuitable or unprocurable as a motor fuel, this capacity should be raised to 45,500,000 gallons. These distilleries should use wheat and sugar-cane products, in proportions having regard to—

(a) strategic considerations ;
(b) the proportion of surplus wheat and sugar to be used as raw material
(c) each State's requirements of liquid fuel ;
(d) the time needed to erect distilleries.

II. The selling price of power alcohol, wholesale at capital cities, should be 2s. per gallon. This is estimated to give a price for sugar-cane products equivalent to about £9 per ton 94 net titre sugar f. o. b. Queensland ports, and a price for wheat of 3s. 6d. (malt process) or 3s. 10½d. (amylo process) per bushel f.o.r. shipping ports. In making this recommendation, the Committee assumes that suitable power alcohol blends would be sold as super grade at a premium of 1 d. per gallon.

III. Sites of distilleries should be decided by :—

(a) strategic considerations ;
(b) location of the source of raw material ;
(c) centres of distribution of liquid fuel.

IV. The distilleries should be owned by the Commonwealth with or without the participation of State Government and/or private interests. Arrangements should be made with experienced organizations to operate them.

V. There should be Governmental action, preferably by State legislation, to ensure :—

(a) the sale of all alcohol of which the selling price is reasonable ;
(b) the best use of such alcohol, by blending with standard grade Petrol in the proportions necessary to produce super grade, or by blending with petrol of lower grade than standard in the proportions necessary to produce standard grade ; and
(c) the sale of alcohol-petrol blends of suitable quality as super fuel under distinctive names indicating the presence of alcohol.

The blend should be sold through the established channels of motor fuel distribution.

VI. A decision should be made before the end of five years of operation as to whether distilleries will thereafter :—

(a) continue in operation ;
(b) be maintained idle as provision against further emergencies ; or
(c) be dismantled.

APPENDIX XXIII.

Report of Special Officer appointed by the Food Department Government of India on FOOD YEAST.

The question of the manufacture of Food Yeast in India first came before the Government of India in 1941. The Secretary of State sent personally to His Excellency Lord Linlithgow a large quantity of literature on Food Yeast and suggested that we should manufacture it on a large-scale. After consultation with E. H. and L. Department and the Supply Department it was decided that the Supply Department should undertake this matter. It was likewise decided that a unit capable of producing 10,000 tons of Food Yeast per annum should be set up as soon as possible and that Messrs. Parry & Co. of Madras would undertake to put this project into effect. At about this time a technical Committee under Sir S.S. Bhatnagar was set up to report on the feasibility of the enterprise. Their report was favourable but not enthusiastic.

2. Messrs. Parry & Co. proceeded with the installation of a small pilot plant at Nellikuppam (Madras) which was a duplicate of the pilot plant erected at Teddington, (London) and capable of producing approximately 400 lbs. per day of Food Yeast. It soon became clear that Parrys could not secure sufficient molasess for a 10,000 ton Food Yeast plant. Their interest was limited to production on pilot plant scale and as a result the whole question of large-scale production was dropped. At the present moment Parrys are not producing any dry Food Yeast. They are converting Yeast Cream into Yeast Extract which is being purchased by the Food Department. However, Parrys have produced a small quantity of Food Yeast similar to that produced at Teddington, but the product is inferior in both colour and taste to the Teddington Food Yeast. (It is possible that this would not have been the case had Parrys used either aluminium or stainless steel fermenting vessels instead of mild steel). It may be noted here that there is no factory at present producing Food Yeast in India.

3. During the period 1941—1944 and whilst these experiments were taking place in India the question of the manufacture of Food Yeast was receiving considerable attention in Great Britain where experiments were proceeding satisfactorily. It is interesting to note that a company called the Food Yeast Co Ltd. was formed by the Ministry of Food whose object it was to produce Food Yeast on a large-scale in both the United Kingdom and British Colonies.

4. The increasing stringencies of the shipping situation and the consequent impossibility of finding shipping space for the molasses required, led to the abandonment of the plan to manufacture Food Yeast in the United Kingdom. Nevertheless the Food Yeast Co., Ltd, was kept in existence with a view to acting as distributing agents for such supplies of Food Yeast as might become available from elsewhere.

5. The Colonial Office took up very seriously the proposal to manufacture Food Yeast in the Colonies. Their interest was three-fold :—

(a) to find a cheap source of highly nutritive food-stuffs much needed by the poorer sections of the Colonial people;

(b) to establish, on a long term policy, a new and profitable utilisation of surplus molasses and sugar ; and

(c) to enable the Colonies to increase their contribution to war-time as well as post-war needs.

The Colonial Office satisfied themselves that Food Yeast was of outstanding value and combined its high nutritive qualities with excellent keeping qualities. Food Yeast offered considerable convenience for shipping, required no refrigeration and was vastly more compact than equivalent quantities of protein in the form of meat.

6. Further investigation and the promising results of the experiments being carried out at Teddington caused the Colonial Office to decide to set up with the shortest possible delay a complete Food Yeast plant in Jamaica capable of producing 3,000/4,000 tons of Food Yeast per annum. As this was a pioneer venture it was decided that it should receive the assistance of public funds provided under the Colonial Development and Welfare Act, 1940. Col. Rt. Hon'ble Oliver Stanley, M. C, M.P., Secretary of State for the Colonies, accordingly made a scheme under that Act providing as interest-free loan of £1,50,000 for this Jamaica project. To administer the scheme Colonel Stanley set up a company named the Colonial Food Yeast Ltd.

7. With the assistance of specialised manufacturers in Great Britain the Colonial Food Yeast Ltd proceeded to design and manufacture a complete industrial unit which is expected to go into production on the Jamaica site in the very near future (June/July, 1945). All technical data and information regarding the Jamaica

plant will be supplied by the Colonial Food Yeast Ltd. upon receipt of any enquiry which is sponsored by the appropriate Governmental authorities. In such cases, they will accept, if necessary, to act as Consultants and co-operate in both the design as well as the erection of plant under an appropriate agreement.

8. In view of the technical progress which had been made in Great Britain regarding the setting up of a scheme to manufacture of Food Yeast on an industrial scale, and partially due to the lack of progress which was being made to set up a similar scheme in India during the same period, the Secretary of State commissioned Mr. N. A. McKenna in February, 1944 to investigate the situation in India and find out whether the Government of India would sponsor the setting up of a unit similar in all respects to the Jamaica plant and capable of producing some 3,000 tons of Food Yeast per annum. It was known that a very large surplus of molasses was available in India and was being produced in sufficient quantity to enable a Food Yeast Factory of this capacity to be set up in any one or several localities. It was also known that the surplus molasses available could be obtained at very little cost and that Food Yeast could therefore be produced in India very cheaply. After consultation with the authorities as well as with Mr. Henry J. Lawless, who had also been deputed to advise the Government of India on technical questions relating to the manufacture of Food Yeast. Mr. Mckenna submitted a Memorandum to the Food Department setting forth the numerous advantages of Food Yeast as a highly nutritive food and the benefits which would result if such a food could be made available to the under-nourished people of this country. This memorandum contains an exhaustive survey of the beneficial aspects of Food Yeast.

9. The new interest which was awakened in this question through the information given by Messrs. McKenna and Lawless caused the Food Department to reopen the matter with vigour and enthusiasm and, as a result, a Committee was formed consisting of:

Dr. Sir S. S. Bhatnagar, Chairman.

Mr. K. L. Panjabi, I.C.S., Joint Secretary,
Deptt. of Food (Division III).

Dr. J.N. Ray, Director of Drugs and Dressings,
Supply Department.

Dr. G. Watts Padwick, Imperial Michologist.
Dr. H. D Sen, Biochemist, Sugar Technology Institute, Cawnpore.

This Committee was appointed to investigate the following questions :—

(a) the desirability of having a Central Yeast Factory of the capacity proposed,
(b) the nature of the ownership and control,
(c) the selection of site,
(d) the method of disposal of effluent, and
(e) the method of disposal of Food Yeast.

10. Upon the recommendation of this Committee the undersigned was appointed Officer on Special Duty and his terms of reference were :—

(a) to report on the best site for the location of a Factory for the production of Food Yeast,
(b) to report on the best method for the disposal of the effluent from the factory.
(c) to report on the agency of construction as well as the running of the Factory, and
(d) to report on the best method of utilisation of Food Yeast from the nutritional point of view.

11. **(a) Best Site and (b) Disposal of Effluent.**

Choice of the most suitable site for the location of a Food Yeast Factory and the question of disposal of the factory effluent are inter-related and must be treated as one problem. The selection of the site depends upon the following factors which are set down in the respective order of importance.

(a) Proximity to source of raw materials (molasses).
(b) Transport facilities.
(c) Disposal of effluent.
(d) Availability of power.

12. A 3,000 ton p.a. Food Yeast factory will require the provision of approximately 10,000/12,000 tons of molasses per annum. This quantity of molasses can be supplied by one or more Sugar Factories which, together, have a total crushing capacity of

3,00,000/360,000 tons per annum or about 2,500/3,000 tons of cane per day for 120 days. There are many localities in the U.P. and Bihar where a group of 2 or 3 Sugar Factories in close proximity of each other can supply the required quantity of molasses and therefore from this point of view there is a large choice of sites available. Any one of these would be suitable as regards restricting transport to a minimum but not all of them are suitable when considering the problem of disposal of effluent. Choice must therefore be restricted to the few points where all these questions can be suitably solved and investigated as proceeded on these lines.

13. There are several methods which could be adopted for disposal of effluent which in the case of a 3,000 ton Food Yeast Factory amounts to approximately 10,000/12,000 gallons per hour. Without going into unnecessary details regarding the more costly and chemical methods of treating factory effluents it is admitted that the cheapest and the easiest means of disposal consists in discharging the effluent into a large river canal, or as in the case of Jamaica directly into the sea. This later means connot be considered in India because there are no Sugar Factories capable of producing the required amount of molasses in reasonable proximity to the sea. Certain sites however do offer the possibility of dumping the effluent into a river or canal and of these the best appear to be :—

(1) Head Works of Sarda Canal at Bambasa. (U.P.)
(2) Near Patna on the river Ganges (Bihar).
(3) Jawalapur on the Ganges Canal below Hardwar (U.P.).

14. The Head Works of Sarda Canal are in the Tarai area which is notoriously malarious. Thus it would be very difficult to maintain the staff in good health and this would result in defective operation if not frequent stoppages of the Factory. Furthermore it is also an out-of-the-way place from the point of view of transport, etc., and therefore the cost of distribution of the final product would be relatively and unnecessarily high. For these reasons this site cannot be strongly recommended.

15. Jawalapur and the site near Patna may be said to be equally suitable from the effluent disposal point of view. The minimum flow of the Ganges Canal below Hardwar is about 4,000 cu.ft. per second whereas the flow of the river Ganges at Patna is many times greater. Within a radius of 100 miles of both these sites there are enough Sugar Factories to supply a 3,000 ton Food Yeast Factory with all their molasses requirements.

16. The site at Jawalapur is preferred for two reasons. The first is because near this point the river Ganges (which feeds the Ganges Canal) comes out of the mountains and being mostly snow-fed, the temperature of the water is consequently very much cooler than at Patna. The second and perhaps less important reason for the selection of the Jawalapur site is that the effluent which is rich in potash and also contains small quantities of phosphates and nitrogenous matter will increase the manurial value of the Canal water which is used by the cultivators for irrigation purposes. Although the actual increase in manurial value to the waters of the Canal will be extremely small it is nevertheless important to note that the effect of discharging the effluent into the Canal will be beneficial rather than harmful. During the annual closure of the Canal for inspection and repairs, the effluent from the Factory could be discharged into the sewers of the Hardwar Municipality which are discharged directly into the Ganges river.

17. Before leaving the subject of the disposal of effluent by dilution or discharged into rivers or canals it would be well to mention here that the standards recommended by the Royal Commission on sewage disposal have been published. These standards show that with the dilution of over 500 volumes all tests might be dispensed with the crude sewage discharged without harmful results. On this basis the effluent from a 3 000 ton Food Yeast Factory discharged into the Ganges Canal at Jawalapur would be diluted approximately 8,000 times— a very large safety factor.

18. The proposed site at Jawalapur is equally suitable from the point of view of availability of raw materials and molasses could be supplied by the following Sugar Factories :

Name of the Factory. (1)	Distance from the Yeast Factory. (2)	Crushing capacity per day. (3)
1. Jai Lakshmi Sugar Co. Ltd., Doiwala.	25 miles.	400 tons.
2. Rai Narain Singh Sugar Mills Ltd., Lahksar.	12 „	12,50 „
3. The Lord Krishna Sugar Mills Ltd., Saharanpur.	47 „	12,50 „

19. The above three sugar mills could provide enough molasses to produce 3,000 tons of food Yeast. In case it is decided at a later date to double the capacity of this factory the following sugar mills could provide enough additional molasses :—

(1)	(2)	(3)
4. Seth Shiv Prashad Banerji Dass Sugar Mills, Bijnor.	63 miles.	1,100—1,200 tons.
5. The Dhampur Sugar Mills Ltd , Dhampur.	64 ,,	950 ,,
6. The Upper Ganges Sugar Mills Ltd., Seohara.	73 ,,	1,300 ,,

20. From the above figures it will be seen that the transport of the required quantity of molasses presents litt e or no problem. The cost of transport of molasses by rail tank wagon is very little indeed and may be reckoned on the basis of 0.3 pie per maund per mile Thus if the total quantity of molasses required was hauled over a distance of 50 miles the increased cost of the molasses would only be 1 anna 3 pies per md. and consequently would only increase the cost of Food Yeast by less than one pie per lb. which is relatively insignificant.

21. A further advantage of the Jawalapur site resides in the favourable climatic conditions prevailing in that area. An adequate supply of cold water would at all times be available and this is important particularly in conection with the growth of Yeast and maintenance of pure fermentation. Dr. A. C. Thaysen who is in charge of the res arch work which has been carried out at Teddington has developed two distinct strains of Food Yeast (Torulopsis, Utilis) having an optimum growth temperature of 30°C. and 39°C. respectively. The latter will be used in Jamaica and its behaviour and development under tropical conditions will be made known to us within a few months. However we may already assume that either of the strains would be suitable to the climatic conditions at Jawalapur whereas it may only be possible to employ the 39°C. Torula if the plant was located near Patna.

22. A 3000-ton Food Yeast factory will require approximately 11000 lbs. of steam at 30 lbs. pressure per hour. It will also require about 250 K W. of electric energy. It follows therefore that if the steam is produced at 200 or 250 lbs. pressure and this high pressure steam is passed through electrical generators it will produce enough electric power to cover the Factory's needs. The exhaust steam from the electric generators can be used for sterilizing the molasses wort and for drying the Yeast Cream. The amount of extra coal required in order to raise steam at 250 lbs. pressure instead of at 30 lbs. will be approximately 8/10 %. It is interesting to note that the production of electric power by this means will cost less than half of the cost of electric power supplied by any of the Electric Supply Companies. However, stand-by power is available at Jawalapur from the U. P. Hydro-Electric Grid.

23. **Agency of Construction and running of Factory.**—There are three alternatives to choose from :—

(a) Government of India financing, erecting and operating the plant.

(b) Government of India financing a plant erected and operated on an agency basis by an industrial organisation.

(c) Government of India guaranteeing an off-take at a controlled price from a plant financed, erected and operated by an industrial undertaking.

24. There are several firms in India contemplating the setting up of Yeast Factories on a relatively small scale. They are willing to co-operate with Government but the amount of capital they have in view to investing for such Factories is only about a lac or two. The manufature of Yeast, Yeast Extract or Food Yeast will only be one of their side lines and not a main interest.

25. A factory capable of producing 3000 tons of Food Yeast per annum would require a capital of approximately 25 lacs. From the information available to-date it is believed that no private industrial concern would undertake such an enterprise unless the Government of India was prepared to guarantee to take up the entire output of the Factory at a price which would enable them to declare a 6% dividend. To do this a concern would have to earn a further 6 to 3% in order to cover income-tax, super taxes, excess profits tax, etc. This means that the capital would have to earn at least 12 to 15%.

26. The Government of India can borrow money at 3% interest and would not have to pay taxes of any description. Therefore if the Government financed, erected and operated the Factory without any outside assistance it would be possible to produce Food Yeast at a much cheaper rate. This saving of 9/10% will reduce the cost of manufacture by 20/35%.

27. The floatation of a public company could not be effected without serious difficulties and delays. In the first place the application would have to be examined carefully by the Department of Capital Issues which in turn would have to consult and obtain the approval of a number of other Government Departments. Difficulties would no doubt be experienced in obtaining all the necessary priorities for the importation of plant and equipment. Other problems, such as the acquisition of land, railway sidings, purchase of essential chemicals. coal for power, bricks, etc., purchase of cement, structural steel and electric equipment, etc., etc., would have to be solved and many delays may reasonably be expected. On the other hand if the Government of India itself were to undertake the setting up of such a Factory most, if not all, of these difficulties would be automatically solved.

28. In addition to the above mentioned difficulties which an industrial concern would have to face there is also the question of disposal of the Food Yeast which naturally could be effected more easily by the Government. It is obvious that without direct Government intervention and backing no industrialists would be able to impose the utilisation and consumption of Food Yeast by the various Departments of the Government through whose agency the greater part of the Food Yeast produced would be consumed. The success of the Jamaica project has only been ensured due to the direct interest aud control of the Ministry of Food through the Colonial Food Yeast Ltd., and therefore it would be advisable for India to follow their wise example. At a later date when Food Yeast has become an integral part of the diet of the poor and under-nourished people of this country it will be possible to envisage the setting up of other plants by agencies outside Government control

29. Should the Government adopt the suggestion made in the preceding paragraphs it will be necessary for them to contract for the supply of all the equipment with a firm of specialised manufacturers. It is standard practice that in such cases where highly technical plant and processes have to be used that the manufacturer of the plant who is chosen to undertake the work is made responsible for the erection as well as the starting up of the complete unit. It is also usual for the plant for a certain number of months or until such time as the local staff has been suitably trained to take over the control. It is suggested that a similar procedure should be adopted in this particular case and that the supplier of the Food Yeast Factory should be called upon to supervise the erection of the plant. started up, obtain the guarantees and operate it for a minimum period of 12 months.

30. It is assumed that it will take from 7 to 10 months after all technical details are settled and the order placed to deliver the plant f.o.b. A further 4 months will be required for shipment and transportation to site. Erection and starting up will occupy a further 6 months and therefore a total of from 14 to 17 months will be required to get the Factory into operation. This allows ample time to train the necessary technical staff to run the Factory. The technical staff in question should spend 3 months at Teddington and 6 to 9 months assisting in the running and operation of the Jamaica plant. At the end of this period the technical staff would return to India in time to assist in the starting up and control of the new Food Yeast Factory Only by this means will it be possible to ensure that the Factory will be built and operated on sound and scientific lines and give the highest possible efficiency camparable to that obtained in other countries.

31. **The best method of utilisation of Food Yeast from the national point of view.—**

This is being investigated by the Public Health Commissioner in consulation with nutritional experts: Dr.W.R. Akroyd and Lt.-Col. Thompson. Their report is not yet ready, but pending receipt of this, the following information may be included in this report.

32. It has been known for some time that micro-organisms particularly yeast, constitute one of the most potent sources of absorbable and water-soluble vitamins of the B complex and in addition form valuable sources of protein of high nutritive value containing amino acids which are essential in animal and human nutrition.

33. The most important vitamins of the B complex are :—

(a) Vitamin B_1 : (Aneurine, Thiamin and Anti-Neurotic Vitamin) prevents the disease Beri Beri.

(b) Vitamin B_2 : 1. Nicotinicamide and Acid is an Anti-Pellagra Vitamin.

2. Riboflavin is a growth promoting factor.

34. The principal deficiency of diet in India are high grade proteins and vitamins of the B complex. Animal proteins (meat, fish and eggs) are practically excluded from Indian diets partially from religious objections and partially because of their relatively high price.

35. So far as the well-to-do people are concerned they can make up their Vitamin deficiency in the form of pills and do not mind the price they pay. The intention of the Government that Food Yeast should be available to the rice eating population, who are very poor and who cannot adequately nourish themselves, is a problem which remains to be solved.

36. The cost of Food Yeast, as estimated by Messrs. Parry & Co., Ltd. is Re. 0/3/11 per lb. on a pre-war basis and 0/5/8 per lb. on the present basis. This price is based on a 20% yield of Food Yeast on the weight of molasses used. At Teddington the yield from molasses is over 25% and some times reaches even 30%. With the increase in percentage of yield the above cost will accordingly decrease. The exact cost of production on a large scale can only be determined after the Jamaica Plant starts producing. The cost for estimation purposes at this stage can be safely estimated at about Re. -/3/- to Re. -/3/6 per lb.

37. If we allow another 2½ annas for distribution charges on the above price, the price to the consumer can safely be taken as Re. -/6/- per lb. The dose of Food Yeast as recommended by the Medical Research Council is quarter of an oz. per day or approximately half a lb. per person per month, which is cheap enough to bring it within the purchasing power of the poor.

38. Unfortunately there is no means of mixing Food Yeast with rice at any stage in the milling, as the rice has a very hard outer surface. Food Yeast mixed with rice in any form will be washed away in the preliminary soaking of the rice or, when rice is boiled, in the water which is thrown away.

39. The best ways in which the rice eating population can take Food Yeast are :—

(1) Cooked with curry or vegetables and taken with rice.
(2) Mixed with spices, it can be sprinkled on rice.
(3) Boiled with pepper water (which is used in Madras and known as ' Rasam ') and taken with rice.
(4) Taken with milk.
(5) Taken in sweetmeats.

40. Food Yeast can be taken more easily by people other than the rice eaters. Even in U.S.A., they find that an average individual requires an extra dose of vitamins of the B complex and accordingly all their cereals products like Post Toasties, Corn Flakes, Grape Nuts, etc., etc. are fortified with Vitamin B_1. India where the nutritional standard is very much lower than U.S.A., certainly needs extra vitamins which can be given very easily to the wheat eating population by an admixture into flour and atta with 2% Food Yeast. This will give them additional vitamins and proteins which are removed from the wheat in the milling process. This mixture can easily be controlled at the source as there are about 50 flour mills in India with a grinding capacity of about a million and a half tons of wheat per year. If all this output is fortified with 2% Food Yeast 25,000 to 30,000 tons will be required for this item alone. If the use of Food Yeast is properly pushed in all directions the consumption can be increased to one lakh tons, within the next 8 or 10 years.

41. Mixture of 2% Food Yeast does not make any alteration in the taste of the bread but the colour is slightly more brownish. The colour in the Chapatti will not be noticed at all. The Food Yeast is dried in the process of manufacture at 120°C. The temperature inside the bread or chapattis while baking does not exceed 100°C. This means that the vitamins will not be destroyed in the baking of the bread or chapattis.

42. Sample breads containing half an ounce of Food Yeast per one lb. loaf have been baked and distributed to some officers of this Department to find out whether they could detect any difference in the flavour of the bread. There was no difference in the flavour but the colour was slightly brownish. Half an ounce per 1 lb. loaf is the equivalent of approximately 5% Food Yeast in the flour. Therefore, if 2% only is added there will be no difference in flavour and the change of colour will be hardly noticeable.

43. Food Yeast can be given to the public in several ways such as :—

(1) All Jails to include Food Yeast in their diets.
(2) To all students in all schools who could be given Food Yeast in some form or another before play time.
(3) All Hospitals to include Food Yeast in patients' diet; this will give them extra vitality which will mean more speedy recovery.
(4) All Health and Maternity Centres to advise their patients to promote the use of Food Yeast.

(5) With proper propaganda and advertisements on the lines of Aspro, Food Yeast can also become popular and be made available everywhere.
(6) It can be sold in Post Offices like quinine used to be sold years ago.
(7) It can be included in the diet of the Army.

44. Critics, in the beginning, may object to the compulsory admixture of Food Yeast in flour and the consumption of Yeast in institutions; but if the Government consider that it is beneficial for the public, they have every moral right and power to do so. With a little propaganda and the realisation of its advantages people soon get used to it (as they have in the case of chlorinated water which is not as pleasant to the taste as unchlorinated water). Any objection that people may have for its use will soon disappear. In England, Chalk (Calcium Carbonate) is added to all flour that is sold, to overcome the calcium deficiency. Therefore, if England can oblige its people to take chalk in flour, the Government of India can also easily oblige hers to take Food Yeast in atta.

Summary and Recommendations.

1. In this country, which is suffering from chronic malnutrition the establishment of a Food Yeast factory is hardly open to question.
2. It has been clearly established that Food Yeast can be manufactured in India on a large scale and at a cheap price.
3 A unit producing 3,000 tons of Food Yeast should be taken in hand immediately. At a dosage of ½oz. per day this will hardly be enough for 11 to 12 lakhs of the population. (The population of Calcutta alone is about 40 lakhs now).
4. Food Yeast can easily be introduced for civil consumption through Government channels to relieve malnutrition.
5. The Food Department should develop the use of Food Yeast as an anti-malnutrition measure.
6. The manufacture of Food Yeast will help in the disposal of surplus molasses which instead of being wasted as at present, will be transformed into a rich food and will give nourishment to the poor population of this country.
7. The best site is at Jawalapur. Effluent disposal does not offer any problem as it can, with advantage, be discharged into a canal.
8. The first plant to manufacture 3,000 tons of Food Yeast should be owned by the Government. This plant, after successful operation for a year or two may be sold to any industrialist, if than the Government so desire.
9. It is estimated that India could easily consume about 100,000 tons of Food Yeast per annum. It should take about 8 to 10 years to attain this consumption if properly tackled. At the dosage of ¼ of an ounce this will be hardly enough for 40 million persons which is only one-tenth of India's present-day population.
10. The ownership of future plants will depend on the experience gained on this 3,000 tons plant.
11. The ways of incorporating.

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GOVERNMENT OF INDIA

DEPARTMENT OF INDUSTRIES AND SUPPLIES

REPORT

OF THE

PANEL ON FINE CHEMICALS, DRUGS

AND

PHARMACEUTICALS

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REPORT OF THE PANEL ON FINE CHEMICALS, DRUGS AND PHARMACEUTICALS.

INTRODUCTORY :—A Panel was formed by the Government of India in the Department of Planning and Development to consider and make recommendations to them regarding the development of the Fine Chemicals, Drugs and Pharmaceuticals Industries. The Panel consisted of the following :—

Col. Sir R. N. Chopra, M.D., I.M.S.—*Chairman.*

Lt. Col. Sir S. S. Sokhey, M.D., I.M.S.—*Member.*

Dr. J. N. Ray, D.Sc. ,,

Dr. K. A. Hamied, Ph.D. ,,

Dr. Habib Hasan, Ph.D. ,,

Dr. V. Subrahmanyan, D.Sc., F.R.I.C. ,,

Mr. C. J. Fielder, B.Sc., F.R.I.C. ,,

Mr. N. Adhikari, M.Sc. ,,

Mr. M.B. Amin, Dipl. Ing. ,,

Dr. M. K. Maitra, Ph.D., D.I.C.—*Secretary.*

Dr. B. B. Dikshit, M.R.C.P., Ph.D., Dr. K. Ganapathi, D.Sc. and Dr. B. C. Guha D.Sc., were subsequently co-opted as members of the Panel.

2. The following general directive was issued by the Government of India to indicate the scope of the Panel and the procedure to be followed by it :

" It is the function of Panels to make recommendations to Government regarding the development of industries, both existing and new. These recommendations should be so framed as to enable Government to prepare a detailed phased plan for the five years following the cessation of hostilities as the first stage of a 15-year plan of industrial development for the whole country.

" In order to assist them to formulate recommendations, Panels will be supplied, as far as possible, with factual information prepared by the Panel secretaries. In the case of new industries, the information will consist of a general survey of the industry and the importance of starting it in India, the availability of raw material, the power requirements, the demands of the Indian markets and the probabilities of exports. In the case of existing industries, the information will naturally be more comprehensive ; it will indicate in addition, the location of existing units, the types of goods produced, the total production under each category and the assistance if any, given by Government. These items are to be regarded as illustrative and not exhaustive.

" Government will give each Panel, as a basis for discussion, the provisional target to be aimed at in the first five-year period and, wherever possible, of the target to be reached in 15 years.

" The recommendations of the Panels should cover the following points :—

(1) The scope and extent of development, including the type of products recommended.

(1-A) The estimated requirements of capital goods together with such details of these requirements as may be available in India and how much should be imported from abroad.

(2) Whether the industry should be under Government ownership either on grounds of national interest or because private capital is unlikely to take it up, and if so, whether it should be wholly or partly managed by Government.

(3) In the case of industries to be developed other than under State ownership, the capital required for such development, whether the whole of it is likely to be available by public investment and, if not, the extent to which Government assistance may be required.

(4) The extent to which technical advice from abroad may be necessary.

(4-A) The availability and the future requirements of technical personnel so as to obtain a clearer indication of the present short-comings and future needs.

(5) The manner and the degree of co-operation with foreign firms considered necessary and desirable, both as regards capital and management.

(6) The location of the industry.

(7) The nature of the assistance required from Government in the form of protective duties, bounties, research grant, expert advice etc.

(7-A) The relative incidence of the import duty on the finished goods in comparison with the duty on the raw materials from which they can be manufactured.

(8) If the industry is to be under private ownership and management, what controls, if any, should be exercised by Government.

(9) What should be the organisation of the different units of the industry, *e.g.*, should there be an industrial association ? Would a cartel be desirable ?

(10) The stages by which the industry should be developed.

(11) Should the industry cater for the export market ?

(12) Should the industry be developed, as in Japan, on the cottage industry basis and, if so, to what extent ?

" Although, as stated above, the panels may recommend the grant of protection, it will not be their function to consider broad questions of international trade and commercial policy.

" Joint meetings of the Panels should be held, wherever necessary, to secure co-ordination particularly where the processes and the products of one industry are connected with those of another.

" Some of the Panels have been drawn broadly and it may be necessary to co-opt members for dealing with specific branches of the industry. Members may be co-opted by the Chairman in consultation with the Industrial Adviser.

" Before submitting recommendations, Panels should consult Provincial Industrial Committees, particularly in the matter of location of industry. They should also, where the circumstances of the case require it, consult Industrial Committees in States or State Governments/Durbars. The recommendations should be submitted to Government through the Industrial adviser."

3. A preliminary note on the manufacture of Fine Chemicals, Drugs & Pharmaceuticals by the Secretary, ' A survey of Drug Industry in India' by Dr. J. N. Ray and a note on ' Coal tar production and refining in India' by Mr. C. J. Fielder were circulated amongst the members of the Panel before its first meeting.

The meetings of the Panel were held on the following dates :—

The first meeting was held on the 5th and 6th October 1945.

The second meeeting was held on the 18th and 19th January 1946.

The third meeting was held on the 3rd and 4th May 1946.

The Panel is greatly obliged to several officials and non-officials who have helped it with information and advice. It will not be possible to name them all individually. The Panel would, however, like to express its special obligations to Dr. B. Mukerji, Director, Bio-chemical Standardisation Laboratory, for the co-operation and help he has rendered and to Dr. B. N. Manjunath, Chief Editor, Dictionary of Economic Products & Industrial Resources of India, for allowing the article on ' Coal Tar production and refining in India ' by Mr. C. J. Fielder, which was written for the Dictionary, to be made available to the Panel.

DEFINITION:—

4. *Fine Chemicals, Drugs and Pharmaceuticals.*—The line of distinction between fine chemicals and heavy chemicals is not always clear. Sulphuric acid, caustic soda, sodium carbonate, etc., which are produced and consumed in very large quantities are usually described as heavy chemicals, while articles such as acetanilide, ethylene glycol, sodium citrate etc., which are manufactured in comparatively small quantities are described as fine chemicals. The vast majority of these are organic compounds and their total number runs to thousands. Fine Chemicals are generally consumed directly, in contrast to heavy chemicals which serve as raw materials for the production of other substances.

5. A considerable proportion of the fine chemicals is used as drugs. In addition, drugs are obtained from vegetable, mineral and animal sources. Pharmaceuticals are preparations of Drugs made up for use.

6. *PRESENT POSITION OF THE INDUSTRY.*—The Fine Chemicals, Drugs & Pharmaceuticals Industry developed considerably during the present war and many firms produced fine chemicals, and drugs; but it must be admitted that this industry is yet in its infancy in this country. A large number of alkaloids

such as strychnine, ephedrine, caffeine, etc., are being produced on a large scale. Many firms have, however, confined their attention to mere refining and bottling the substances which could not be produced in the country. Synthetic drugs produced in this country at present are mostly made out of imported materials. To place the manufacture of Drugs and Pharmaceuticals on a firm footing, it is of fundamental importance that Fine Chemicals should be produced in the country in requisite quantities.

7. *OBJECT TO BE ACHIEVED.*—The Panel considers that it should be the object to make India self-sufficient in regard to Fine Chemicals, Drugs and Pharmaceuticals within the next 15 years. In a vast tropical country such as India, the requirements of drugs are large. The country must produce all essential drugs and make them available for the use of the masses.

8. *GENERAL SCHEME OF PRESENT REPORT.*—It has not been considered necessary, nor would it have been possible to deal individually with the vast number of fine chemicals and drugs. The main sources of these and the general problems connected with their manufacture have been discussed in this report. Attempt has been made to focus attention on certain drugs and chemicals which are of special importance and the large scale productions of which are urgently required in this country. The difficulties which are at present hampering the production have been considered and the means by which these could be removed and the production could be placed on a sound basis have been indicated.

9. *RAW MATERIALS FOR THE MANUFACTURE OF FINE CHEMICALS AND DRUGS.*—The raw materials from which fine chemicals and drugs are derived may be divided into the groups mentioned below. The production of these groups of articles will have to be sufficiently developed as first essential to the manufacture of fine chemicals and drugs on a large scale :

(*a*) *Inorganic Chemicals*, such as Chloro-sulphonic, sulphuric, nitric and hydrochloric acids, sodium hydroxide, sodium carbonate ; sulphur, phosphorus, ammonia ; chlorine, bromine, iodine ; metals such as arsenic, antimony, sodium, potassium, calcium, mercury, iron, zinc etc., and their derivatives.

(*b*) *Coal distillation* products such as benzene, toluene, naphthalene, anthracene, pyridine, phenol, higher phenols, etc.,

(*c*) *Wood distillation products*, such as methyl alcohol, acetic acid, acetone, etc.,

(*d*) *Fermentation products* such as ethyl alcohol, butyl alcohol, fusel oil, acetic acid etc.,

(*e*) *Petroleum products* such as petroleum ether, petrolatum (Vaseline), liquid petroleum, paraffin wax etc.,

(*f*) *Animals products*, such as tissues and glands of animals.

(*g*) *Vegetable products*, such as roots, barks, flowers, leaves and seeds of plants.

(*h*) *Synthetic Chemicals* derived from acetylene, ethylene and other aliphatic chemicals including products obtained by hydrogenation of carbon monoxide etc.

10. *Inorganic Chemicals.*—The successful manufacture of Fine Chemicals and Drugs is to a great extent dependent on the availability of certain basic chemicals such as the main acids and alkalies, common inorganic sulphates and phosphates, and essential gases such as Chlorine, ammonia, carbon-dioxide, Hydrogen etc. Sufficient quantities of almost all these chemicals are available and their further expansion has been considered by the Heavy Chemicals Panel, which has made recommendations for increased production of these at commercial rates. Hence, nothing further need be written about them here.

11. *Distillation Products of Coal.*—These constitute some of the most valuable raw materials. It would be necessary to develop coal distillation industry to the furthest possible extent and to place it on a sound and rational basis.

12. Coal distillation is carried out primarily for the purpose of producing either metallurgical coke or coal gas. In India over 80% of the coal distilled is coked in high temperature coke ovens, the main product (coke) being to a very large extent consumed in the Iron and Steel Industry. The quantity of coal distilled in gas retorts in India is comparatively small and is limited to that processed by the Bombay and Calcutta Gas Companies. The potential coking capacity of coke ovens in India is estimated at 3·5 million tons of coal per annum, but owing to the shortage of Coal the out-put of Coke has been very seriously reduced during the last 3 years, or so.

13. Coal Tar produced represents only approximately 2·5% by weight of the Coal distilled in the Coke ovens. In 1941, the quantity of Coal Tar produced in India was 80,000 tons of which approximately 60,000 tons were distilled, but due to coal and fuel shortage these quantities have been very greatly reduced and the amount of tar available for distillation dropped to 50% approximately of the pre-war figure with the result that the distillery plants have only been partially engaged.

14. Low boiling Tar Bases (Pyridine) etc., are present in Gas Tar but only in very small amounts. Indian Coal Tars have only traces of benzene and toluene and contain about 5% of Napthalene, tar acids (phenol, cresol etc.,) and tar bases (pyridine etc.,). Approximate war time production from Indian Coal tars has been as follows :—

Naphthalene	..	..	600 tons per annum.
Phenol	..	..	50 tons per annum.
Cresols	..	..	100 tons per annum.

In the case of Phenol the potential output from Coal Tar is quite inadequate and the greater part of the estimated demand must therefore be met from synthetic production. In the case of Cresols the potential production should be capable of meeting 50% of the estimated demand.

15. Coal distillation gases, after separation of Coal Tar and before being used as fuel are being stripped of Crude Benzol which may be refined to yield Benzene, Toluene and Xylenes. (Solvent Naphthas). Besides the two small recovery plants at Bararee Coke Co., and State Railways Colliery, Giridih,

E. I. Railway, the important Benzol Recovery plants are situated at the two main Steel Works (Tata Iron and Steel Co., Jamshedpur and Indian Iron and Steel Co., Ltd., Hirapur). These Recovery units are the property of the Government of India, but are operated on behalf of the Government by the respective Steel Companies under agreement for a certain number of years. In the event of the Government deciding at any time to discontinue operation of these plants and to dispose them off the Steel Companies have the option to acquire them. The capacity of these Benzol Recovery Units is as follows :—

Benzene	2·1 million gallons per annum.
Toluene	0·42 million gallons per annum.
Solvent Naphtha	0·10 million gallons per annum.

From the above it will be seen that the " Coal Tar Industry ", *i.e.*, the production of Coal Tar at the Works of the Iron and Steel Cos. and the distillation and by-product refining at the distillation plants is established in India and has been for some time producing certain by-products required by the Fine Chemicals Industry. Benzene and Toluene are produced in Coke Oven Gas Recovery Units at the Steel Works. These plants are Government owned and it is desirable that the Government of India should continue them in operation, utilising the products as a motor fuel until such time as the fine chemical industry is ready to absorb them.

16. The by-products obtained from Coal Tar distillation are no longer under statutory control imposed during the war, but there should be no difficulty in these products being produced and earmarked for the Fine Chemicals Industry.

17. The coke ovens in India are primarily designed to produce metallurgical coke. Consequently, the temperature of coking is high. Naturally such tars owing to polymerisation become richer in Naphthalene hydrocarbons. The best tar suitable for by-product recovery is obtained where the temperature of coking is comparatively low. But the coke from such ovens is not entirely suitable for metallurgical purposes. It is for this reason that large scale modification of the coke ovens cannot be immediately carried out. The Fuel Research Board may well consider the problem connected with the production of tar more suitable for by-product recovery from Indian coal. The Government of India should make available to the industry all data that they may possess on the distillation of Indian coal.

18. The manufacture of intermediate and synthetic products from the primary coal tar products has not yet been developed in the country. The most important basic material essential for such development is, however, Benzene, which is now available in good quantity. The coal tar intermediates for the preparation of drugs and dyes are common, and there should be a close co-ordination in the plans for the development of the manufacture of dyes and drugs in this country.

19. *Wood Distillation.*—There is at present only one wood distillation plant in India, situated in Mysore. This is capable of carbonising about 250 tons of wood per day. The by-product recovery plant is able to treat daily about 30,000 gallons of wood distillate and produces the following products :—

Calcium acetate,
Methyl Alcohol (crude and refined),
Methyl Acetone,
Refined wood tar,
Wood Tar pitch,
'Black paint,'
and wood preservative.

20. Until recently, the greater part of the production of calcium acetate was taken by the Government of India for the preparation of acetone. Acetone is now made in the Government of India factory from ethyl alcohol. The Mysore Iron and Steel Works propose to make arrangements for the direct recovery of acetic acid from the pyroligneous liquor. There is a considerable demand in India for acetic acid, which is estimated at present to be between 250 to 300 tons per year. During the war the demand was considerably higher and it is expected that the demand for acetic acid by the end of the next ten years may go up to 1,000 tons per annum. There is also a good demand for methyl acetone as a solvent, in various industries. Formaldehyde, obtainable from methyl alcohol, is used for the manufacture of synthetic resins, in the tanning industry and as an antiseptic. The demand for formaldehyde is steadily increasing and is expected to be not less than 1,000 tons per year by the end of next ten years.

21. New processes have been evolved, however, for the manufacture of acetic acid, acetone, methyl alcohol and formaldehyde. In industrially advanced countries, relatively small fractions of these materials are now produced from the distillation of wood. Acetic acid is manufactured from acetaldehyde, derived from acetylene or by the oxidation of ethyl alcohol. It is also produced by fermentation. Acetone is prepared by fermentation processes. Methyl alcohol is synthetically prepared from carbon monoxide and hydrogen, and formaldehyde is prepared from it. It will take some time before the above processes are properly developed in the country. In the meantime, particularly in parts of India where there is demand for wood charcoal and suitable varieties of wood are available cheaply and in abundance, the possibility of economic working of wood distillation plants may be further examined.

22. *Fermentation Products.*—Ethyl alcohol is the only product which is produced in India on a large scale by using the process of fermentation. The Panel on Sugar, Alcohol and Food Yeast has recommended a scheme for large increase in the production of anhydrous power—alcohol from molasses. The fermentation process should also be developed for the preparation of butyl and amyl alcohols and products such as lactic acid, butyric acid, gluconic acid, acetic acid, citric acid, glycerol, acetone and l-Sorbose, which is a necessary intermediate in the synthetic production of ascorbic acid or vitamin C. The preparation of malt on a large scale is one of the industries, which should also be developed.

23. The fermentation industry is of the greatest importance to the country and its development should be taken in hand without delay. Some of the existing alcohol distilleries fabricated in the country are working efficiently and give the hope that other fermentation products could also be produced successfully. Any special difficulty arising out of an individual process of fermentation and on account of high temperatures prevailing in the country could be overcome successfully.

24. *Petroleum Products.*—Apart from petrol, kerosene and lubricating oils, crude petroleum yields a number of products used in the drug industry. There are at present two refineries in India for the refining of crude petroleum, one of these is in Assam and the other is in the Punjab. It should be possible to obtain from indigenous petroleum India's requirement for the following products :—

(1) Petroleum ether,

(2) Liquid petroleum or white mineral oil,

(3) Paraffin wax.

25. *Animal Products.*—In the ten big cities of India, namely Calcutta, Bombay, Delhi, Madras, Hyderabad, Lahore, Karachi, Lucknow, Dacca and Bangalore, over three million sheep and goats, and over three hundred thousand buffaloes, bullocks, cows and calves are slaughtered per annum. Though many of the animals handled at these slaughter houses are of poor quality and undernourished, the amount of glandular material obtainable from these is adequate enough to meet the greater part of the country's requirements for insulin, thyroid, adronaline and posterior pituitary exratcts, liver extracts etc.

26. Adrenaline, thyroid and pituitary extracts are now being made by the Indian pharmaceutical concerns. It should not be difficult to greatly extend this production. Large quantities of liver extracts, both for oral and parenteral use, are also being made in the country. Animal bile is being used for the preparation of sodium taurocholate and glycocholate and dehydrocholic acid. In these also India could be mostly self-sufficient.

27. At present the arrangements for the collection of animal tissues and glands from the slaughter houses are very unsatisfactory. The materials should be made available to the manufacturers in a fresh condition to obviate any possibility of deterioration. Quick removal of the glands etc., after slaughter and their immediate freezing on the spot will require to be provided. Cheap transport facilities in cold storage will also have to be arranged.

28. Vaccines are produced in the country in large quantities and the present needs of the country are being met. The Government laboratories have among them a production capacity of about 8 million C. Cs. per month of bacterial vaccine. The capacity of production of private firms are 22 million C. Cs. per month. This production can be increased if larger quantities of vaccines are needed. Besides these existing laboratories, it is recommended that all Provincial Governments should organise their own bacteriological laboratories in the near future. Some private firms have also been making bacterial vaccines. The production in these, it is expected, will continue to increase.

As regards rabies, vaccines and vaccine lymph the existing Government laboratories can adequately meet the demands. Stoppage of supplies of Agar-Agar from Japan produced difficulties in the manufacture of vaccines during the war. This difficulty has been successfully met by the production of Agar-Agar from indigenous sources. It is necessary that the manufacture of Agar from indigenous sources should be further developed.

29. In recent years increasing quantities of antitoxins and sera of good quality are being made in the country. The present demand for these products is small but it would increase as medical relief organisations in the country develop. To meet the increasing demand it is recommended that all Provincial Governments should organise laboratories. In addition to the Government laboratories some commercial firms have also been producing anti-toxins and sera and there is no doubt that they will also increase their production.

A note by Sir S. S. Sokhey on the manufacture of Vaccines, Anti-toxins and Sera may be seen in Appendix X.

30. *Vegetable Products.*—(Including fixed and Essential oils).

India is favourably situated regarding the preparation of vegetable drugs; there is a wide variety of soil and climatic conditions, in which plants of all kinds can be grown. Apart from the large number of drugs used in the indigenous systems of medicine about 75% of the vegetable drugs mentioned in the British Pharmacopoeia can be prepared from plants grown in India. Certain of the Indian plants yield drugs which though not identical to those recognised in B. P. and B. P. C. have therapeutic properties similar to expensive imported remedies. Some of these are Ipomia Terpothum, Picrorrhiza Kurruoa, Polygola chinensis etc. Tinctures and extracts of these drugs have been made. Important drugs such as codein, quinine, ometin, strychnine, ephedrine, caffeine, santonin, etc. are also already being made in the country.

31. With careful cultivation, the resources of the country for some of the more important vegetable drugs could be greatly increased. The most important need at the present moment is to very greatly increase the production of cinchona. The cultivation of such plants as pyrethrum, ipecac, artomesia, etc. should also be greatly increased. A recent successful cultivation has been of Ergot of rye in the Nilgiris. The cultivation of this fungus should be carried out under strictly controlled conditions, in consultation with the Agricultural Department. Steps to be taken to increase the cultivation of medicinal plants should have in view not only the requirements of the country but also the export trade. Medicinal plants growing in the country are a real wealth of the nation and this wealth should be fully exploited. An inquiry should be instituted into the whole question of production of these drugs on a large scale ; to improve quality and reduce cost, to enable Indian products to meet foreign competition.

32. At present there is no organisation for the cultivation and sale of vegetable drugs. The manufacturers have to obtain their requirements from the local dealers. The roots, barks, leaves, etc., of plants as they are available are often in unsatisfactory condition and deficient in their drug content. There is no system of grading of crude drugs. Right species and types are not

available and spurious substitutes are often passed in their places. There should be a Government organisation in each province, or group of provinces, for improvement in cultivation and collection of medicinal plants. The Government should also organise stores where vegetable drugs of all kinds, properly stored and graded, would be available in good condition to drug manufacturers.

33. Plants from which important fixed and essential oils are obtained namely chaulmoogra, castor, linseed, sandal wood, citronella, eucalyptus, palmrosa, lemon grass oil, cardamom, etc., are all grown in this country. India has got adequate resources for the distillation of essential oils. If the raw materials are properly collected, adequate quantities of oils could be produced which will not only be sufficient for the internal demand, but will leave enough for export purposes.

34. The subject of the essential and fixed oils is being dealt by the panel on Oils and Soaps. The present panel recommends, however, that for the increase of production of these oils the following measures may be taken :

(*i*) Forests and wild grasses yielding essential oils should be preserved from damage with the help of the Revenue and Forest Departments, in order that the produce could all be utilised.

(*ii*) The Agriculture Department should carry on propaganda and give necessary help to the cultivators in cultivating and selling varieties of grasses seeds fruits, etc., yielding essential oils.

(*iii*) Selected varieties yielding more oil should be grown.

(*iv*) The distillations should be carried out in well planned and scientific manner so that maximum yields may be obtained.

(*v*) Marketing should be properly organised so that the products sold are not adulterated. This would help to build up a reputation for the Indian products and increase its demand.

35. *Synthetic Chemicals.*—In addition to the large number of chemicals obtained by direct distillation or extraction from natural sources, such as coal, wood, plants, etc., chemists have been able to build up an increasing number of valuable materials from simple substances. Some of the most important chemicals used in medicine have been prepared synthetically. Local and general anaesthetics such as veronal, avipan, novocaine, etc., highly active antiseptics such as acriflavine, crystal violet, D. D. T., etc., diuretics, antipyretics, hypnotics and sedatives, etc., are all being prepared by synthetic means. Many of the active principles of natural drugs, vitamins and hormones and the highly important modern chemo-therapeutic remedies such as sulphanilamide, sulphathiazole, etc. have also been manufactured synthetically.

36. A vast quantity of synthetic chemicals have been prepared in recent years in scientifically advanced countries from sources other than the products of distillation of coal. Nearly 2,000 million pounds of these materials, valued at 266 million dollars, were produced in U. S. A. alone in 1940. It is essential that this important branch of synthetic chemical industry which has so far been neglected in India should be properly developed. By catalytic hydration

of acetylene, acetaldehyde is formed, from which by catalytic oxidation, acetic acid is produced. Synthetic acetic acid is gradually replacing the acid obtained by wood distillation. By chlorination of acetylene, tetrachloroethane is formed, and from this an important solvent, trichloroethylene, is prepared. Other chlorinated hydrocarbons, such as perchloroethylene, pentachloroethylene etc., are also made from acetylene. Vinyl acetate, prepared by the action of acetic acid on acetylene, is hydrolysed to form polyvinyl alcohol. The rubber substitute neoprene, is a polymer of chloroprone, which is derived from acetylene and chlorine.

37. From ethylene prepared from alcohol by catalytic dehydration, or from petroleum cracked in the vapour phase, a series of important chemicals are synthesised. Ethylene glycol is obtained from ethylene. The monoethyl ether of ethylene glycol is an important solvent for gums, resins and nitrocellulose.

38. Methyl alcohol is now mostly prepared synthetically from carbon monoxide and hydrogen. In the United States of America, 24 million gallons of synthetic methyl alcohol were prepared in 1940, as against 5 million gallons produced from wood distillation. By varying the catalyst and altering the conditions of reactions, methane, methanol and higher alcohols are formed from carbon monoxide and hydrogen. Methyl alcohol or methanol forms the raw material for the preparation of methyl chloride and formaldehyde.

39. Synthetic chemical industry has hardly been developed in this country. A few articles are prepared on a laboratory scale mostly from imported starting materials. The preparation of synthetic methyl alcohol from carbon monoxide and hydrogen and of synthetic chemicals from acetylene, ethylene etc., will have to be developed on a large scale and the distillation products of coal such as benzene, toluene, naphthalene, anthracene should be available in sufficient quantities. Synthetic production of drugs and fine chemicals will have to be carried out under the supervision of trained chemists and the availability of chemists with sufficient skill in chemical operations is an essential requirement.

40. TARGETS OF PRODUCTION.— In order to achieve the object of making India selfsufficient in regard to the more important Drugs and Fine Chemicals the following figures of production should be reached within the next 10 years :—

DRUGS.

	Production targets per annum.
Quinine	2,000,000 lbs. per annum in 15 years
Morphine	3,000 lbs. per annum in 10 years
Codein	1,500 lbs.
Caffeine	30,000 lbs.
Strychnine	16,000 lbs.
Ephedrine	5,000 lbs.
Santonine	3,000 lbs.
Emetine	2,000 lbs.
Belladona pulvarata	50,000 lbs.
Mepaerine	160,000 lbs.
Pamaquine	5,000 lbs.
Sulpha Drugs	500,000 lbs.

Penicillin	1,000,000 million units.
Streptomycin	as much as possible.
Sulpharsphenamine	100,000 lbs.
Neoarsphenamine	100,000 lbs.
Para-carbamino phenyl arsonic acid	100,000 lbs.
Procaine hydrochloride	500 lbs.
Cocaine hydrochloride	100 lbs.
Percaine	25 lbs.
Atropine	150 lbs.
Veronal	25 tons.
Lumenal	25 tons.
Hexamine	50 tons.
Argonti Proteins (Protargol)	5 tons for medicinal use.
Aspirin	50 tons.
Vitamins.	
Shark Liver Oil	1,000,000 gallons of oil of average potency of 6,000 units per gm.
Vitamins A, B groups, C and D	Targets of production have not been fixed for these. It is understood that the Technical and Planning Panels of the Food Dept. are dealing with this question.
Hormones.	
Adrenalin (base)	50 lbs.
Desoxycorticesterone	10 lbs.
Thyroid	Production of these on a commercial scale should be started.
Pituitary	
Insulin	
Estrone	
Progesterone	
Testeosterone	
Stilboestrol	
Liver Extracts.	
Injectible	50,000,000 c.cs.
Oral	200,000,000 c.cs.
Insecticides.	
Pyrethrum	50,000 tons of dry flowers.
D. D. T.	30,000 tons (dealt with by the heavy chemicals panel).
Paris Green	5,000 tons.
Refrigerating Chemicals.	
Freon	400,000 lbs.
Methyl chloride	200,000 lbs.
Photographic Chemicals.	
Sodium thiosulphate (hypo)	1,000 tons.
Sodium sulphite	300 tons.
Sodium bisulphite	800 tons.
Pyrogallol	20 tons.
Hydroquinone	50 tons.
Amidol	5 tons.
Metol	20 tons.
Fine Chemicals.	
Phenol	250 tons (for drugs alone).
Phenetidine	200 tons.
Phenacetin	50 tons.
Para anisidine	50 tons.
Benzaldehyde	20 tons.
Benzoic acid	20 tons.

Acetophenone	10 tons.
Resorcinol	25 tons.
Cresols	1,000 tons.
Xylenols	500 tons.
Phthalic anhydride	20 tons (for drugs manufacture).
Phthalic acid	100 tons.
Acetic anhydride	250 tons.
Monochloracetic acid	100 tons.
Citric acid	500 tons.
Lactic acid	100 tons.
Stearic acid	1,000 tons.
Formaldehyde	1,000 tons.
Ethylene oxide	50 tons.
Diethyla mine	50 tons.
Malonic ester	100 tons.
Acetoaceticester	150 tons.
Formicester	100 tons.
Urea	100 tons.
Thiourea	60 tons.
Guanidine nitrate	200 tons.
Glucose	500 tons.
Lactose	750 tons.
Barium peroxide	100 tons.
Phosphoric acid	100 tons.
Phosphorus oxychloride	450 tons.
Thionyl chloride	100 tons.

Solvents.

Alcohol (ethyl)	10,000,000 gallons.
Methyl alcohol	1,200 tons.
Butyl and isobutyl alcohols	500 tons.
Amyl and isoamyl alcohols	500 tons.
Acetone	1,000 tons.
Methyl ethylketene	200 tons.
Ether (ethyl)	250 tons.
Chloroform	500 tons.
Carbon tetrachloride Tetrachlorethylene	250 tons.
Acetic acid	1,000 tons.
Ethyl acetate, Butyl acetate, Amyl acetate	1,500 tons.
Benzene	2,000,000 gallons plus about 3,000,000 gallons for production of DDT.).
Toluene	500,000 gallons.
Pyridine (refined 22°)	250 tons.
Nitro benzene	200 tons.
Trichlorethylene	20 tons.
Glycol	1,000 tons.

Miscellaneous articles.

Metallic Sodium	500 tons.
Activated carbon	250 tons.
Agar	10 tons.
Starch	1,000 tons.

41. DIFFICULTIES HAMPERING THE DEVELOPMENT OF THE MANUFACTURE OF FINE CHEMICALS DRUGS AND PHARMACEUTICALS WITH SUGGESTIONS AS TO HOW TO OVERCOME THESE.—The main difficulties could be stated as follows :—

(*a*) supply of raw materials ;

(*b*) heavy cost of transport ;

(*c*) provincial excise rules ;

(*d*) lack of control over standards of drugs and chemicals ;

(*e*) existing patent laws.

42. *Supply of Raw Materials* :— The raw materials needed for the fine chemicals and drugs industry have already been discussed. As already stated basic chemicals such as, the main acids and alkalies, are available. The prices of these are, however, in many cases too high. With further expansion in the manufacture of these, as is being recommended by the Heavy Chemicals Panel, the prices are likely to come down. The manufacture of increased quantities of intermediates from the distillation products of coal for the preparation of drugs and fine chemicals should be taken in hand immediately. The manufacture of adequate quantities of solvents and of crude vegetable drugs of proper quality should also be organised.

43. *Heavy Cost of Transport.*— The cost of transport of raw material from one part of the country to the other is too high at present. This is an important factor in raising up the cost of production of Indian goods and is responsible for the difficulties experienced by Indian manufacturers in facing competition from abroad. The Railway freights on crude drugs, as in the case of cereals, should be cut down to the minimum.

44. *Provincial Excise Rules.*— A revision of the provincial excise rules is urgently called for. The manufacturers and distributors are greatly handicapped at present owing to the high price of alcohol and the existence of provincial excise barriers, and of different excise duties in the different provinces. These questions were taken up very strongly by the Drugs Enquiry Committee in 1931. The duty on alcohol, however, still remains high, and the necessary alterations in the Provincial Excise Rules have not yet been effected. On account of the existence of provincial excise restrictions spirituous preparations cannot be transported from one part of the country to the other without evercoming a great deal of vexatious interference. This acts very prejudicially against Indian manufacturers as imported preparations containing alcohol move freely from one part of the country to the other once they had passed the Customs authorities at the Port. In keeping with this, Indian made spirituous preparations should at least be given the same facility of movement from one part of the country to the other as imported spirituous preparations, when once the duty has been paid at the place of manufacture.

45. The Panel on Sugar Alcohol and Food Yeast which has recommended a scheme for a large increase in the production of alcohol also considers that all inter-provincial excise barriers regarding labelling, bottling, etc., of industrial alcohol and spirituous preparations should be abolished and the whole of India should be treated as one unit. A uniform excise policy should be adopted throughout the country and local variations in excise rules should be abolished, as far as possible. The excise duty on spirituous, medicinal and other preparations in all Provinces and States should be uniform. For the manufacture of Fine chemicals and Drugs where Sugar is used as a basic raw material, the present excise duty on sugar should not be levied.

46. *Lack of Control over Standards* :— Although the Drugs Act was passed in 1940, it has not yet been put into operation and there is at present no control over the quality and strength of drugs as sold in the market. Spurious drugs, and alkaloids and biological products below their strengths are now being sold with impunity. This is a very undesirable state of affairs and should end immediately. The Panel, therefore, recommends that the Drugs Act should be immediately brought into force and the provincial governments should take steps to organise Drug Testing Laboratories to implement the Act.

47. A Bill for the introduction of a Pharmacy Act was recently placed by the Government before the Legislative Assembly. Along with the application of the Drugs Act, the Pharmacy Act should be brought into operation, which would make it compulsory for all pharmacies dispensing drugs to employ only qualified compounders, who have received proper training. There should be provision in the rules for ensuring that all medicinal preparations should be accurately dispensed and should contain ingredients of standard purity and strength.

48. *Existing Patent Laws.*— Another very serious hurdle in the development of this industry in the country is the existence of foreign patents covering the process of manufacture of drugs and many essential chemicals. Most of the important processes for making the drugs and chemicals urgently needed for the country are so covered. Sections 22 and 23 of the present Patents Act do seem to provide a theoretical remedy for obtaining compulsory licences from foreign patentees. Licences can be claimed on the plea that " the demand for a patented article is not being met to an adequate extent and on reasonable terms " and that " the patented article or process is manufactured or carried on exclusively or mainly outside India ". In practice it is almost impossible to get a compulsory licence under these sections as they are at present worded. There has not been a single case in India where compulsory licence has been granted under the Patents Act. England was faced with a similar difficulty and the matter was set right by materially altering the Patents Act. These two sections (sections 22 and 23) of the Indian Patents Act require to be modified on the same lines as the British Patents Act. The Controller of Patents should be consulted in this matter and necessary action taken.

49. MENACE OF NON-ETHICAL PATENT AND PROPRIETORY MEDICINES—In the prewar years India used to import proprietory and patent medicines of the value of Rs. 60 to 70 lakhs per annum. On account of the dearth of shipping

space and the manufacturers of patent medicines abroad being engaged in more important work, the import of this class of goods has been reduced to about Rs. 20 lakhs in the year 1943-44. Now that the war is over, Indian market is sure to be flooded again with this class of articles of foreign manufacture. No figures are available as to the indigenous production of patent and proprietory medicine in this country. It has, however, been estimated that, excluding those coming under Ayurvedic and Unani medicines, the total value of these goods produced is not less than half a crore of rupees. If we take into consideration the secret preparations classed under the Ayurvedic and Unani Systems of medicine, the total value of this type of articles from all sources, consumed in this country would run upto about two crores of rupees per annum. Barring a few exceptions, these preparations are entirely worthless. Some of them actually contain ingredients that are positively injurious. Grossly exaggerated claims of efficacy are made for the secret remedies and they cause incalculable injury by leading sick persons to delay in securing proper medical treatment. There is at present no provision at all in this country for the checking of this dangerous trade. The actual loss to the country in money and in health is tremendous. Immediate and drastic steps should be taken to eliminate, as far as possible, this trade in secret drugs which is thriving on the ignorance and credulity of the people.

50. IMPORTANCE OF CONCENTRATING ON THE MANUFACTURE OF SOME ESSENTIAL DRUGS.—It is considered that India should be able gradually to become selfsufficient in her requirements of fine chemicals and drugs. There are, however, certain essential items for which the need is very great and urgent. During the next 5 years it seems specially desirable that we should concentrate our attention on the production of the following articles of vital importance for the health and well-being of the nation :

Vegetable Products	..	Quinine, Pyrethrin, Emetin, Strychnine, Santonin, Ephodrine, Caffeine, Morphine.
Synthetic Chemicals	..	Sulpha Drugs, Mepacrine, Paludrine DDT, Carbarsone, Sulpha-arsphenamine, Nearsphonamine.
Anti-biotics	..	Penicillin, Strepto-Mycin.
Vitamins :	..	Vitamin A Vitamin B (complex) Vitamin C.

(*Vegetable Products.*)—The plants from which the active principles, Quinine Pyrethrin, Emetin, Strychnine, Santonin, Ephedrine, Caffeine, Morphine could be extracted are all now grown in India. In order that the target of production of the drugs, as set out by the Panel, could be reached, it would be necessary in most cases to extend very considerably the cultivation of the plants. The processes of extraction of active principles from the plants are simple in all cases and would present no difficulty. The other requisites would be the availability of adequate quantities of organic solvents such as alcohol,

chloroform, ether, acetone, benzene, petroleum ether etc., alkalies such as caustic soda, lime, sodium carbonate and ammonia, acids chiefly sulphuric and hydrochloric. All of these are produced in large quantities in India and the production can be increased as needed. For the production of Quinine 2 million lbs., Emetin 2000 lbs., Strychnine 8,000 lbs., Ephedrine 5,000 lbs., Caffeine 30,000 lbs., and Morphine 3,000 lbs. per annum, it will be necessary to use the following quantities of solvents : 450,000 lbs. of commercial Benzene, 100,000 lbs. of Naphtha, 40,000 lbs. each of Petrol, Chloroform and Ether per annum. In addition, a large quantity of Batching oil will be required for quinine extraction, but the loss of this solvent in the manufacture is practically nil and annual replenishment of the solvent need not be taken into consideration.

51. *Quinine.*—(Target of production 2,000,000 lbs. per annum). About one hundred million cases of malaria occur in the country every year and about 1½ million people per year die of this disease. Most of the deaths and sufferings due to malaria are preventable. Apart from other measures such as adequate nourishment and improved hygienic conditions, the most important requirements in the control and eradication of malaria are the availability of adequate quantities of quinine or other antimalarial drugs and of mosquitocides such as pyrethrin or DDT. The drain on the resources of the country on account of the disability brought about by malaria is tremendous. The efficiency of the people is impaired, the vitality of the nation is markedly lowered and far-reaching economic loss to the country is caused by the wide prevalence of this disease. It has been estimated that over a thousand million working days per year are lost on account of malaria. Even if the value of work of an individual is reckoned as low as /4/- annas per day, the total loss to the country works out to about 25 crores of rupees per annum.

52. The pre-war production of quinine in the country was about 70 thosand pounds per year. Roughly 130 thousand pounds of the alkaloid were imported from abroad. The present production of quinine is about 100 thousand pounds per annum ; there is no import at all at the moment as it is not possible to obtain quinine from countries like Java which supplied India before the war. Calculating on the basis of 100 grains of quinine required for the treatment of a case of malaria and taking into account the quantity needed roughly for prophylactic treatment, India's need for quinine works out at about 2 million pounds per year. The present production of quinine is, therefore, not able to meet even 5 % of the country's need.

53. Cinchona plants are at present grown in the Darjeeling district and in the Nilgiris. There is a vast scope for increase in the cultivation of different varieties of cinchona tree in these areas as well as in other parts of India where the climatic conditions are suitable. It has been estimated that there is enough suitable land in India for the cultivation of cinchona to meet all the needs of the country for quinine and similar alkaloids. There has been considerable discussion as to whether the varieties of cinchona at present cultivated in Government plantations are the most suitable. The Drugs Enquiry Committee of which Sir R. N. Chopra was the Chairman reported that attention had been paid only to the planting of the variety of cinchona yielding quinine.

This variety was too delicate. Sturdier varieties of the plant yielding analogous alkaloids such as quinidine, cinchonine, cinchonidine, which were equally effective as antimalarials should be more suitable for growing in India. Immediate steps should be taken to carefully examine this point and to establish what types of cinchona are the most suitable for growing under Indian conditions and would give the largest recovery of the required alkaloid. The acreage under cinchona should be extended as much as possible without delay. Cinchona plant is comparatively slow in growth and generally takes 6 to 8 years to mature. The Russian method of production of quinine, which considerably shortens the period of cultivation of the plant has to be carefully investigated and, if necessary, the Russian method should be modified to suit the conditions provailing in the country.

54. *Pyrethrin.*—(Target of production 50,000 tons of dried pyrethrum flowers.) In the fight against malaria greatest sucess has been achieved in recent years by the employment of anti-mosquito sprays containing pyrethrin, which has proved remarkably effective in the extermination of mosquitoes which are responsible for spreading malaria.

55. Before the war Japan, which used to produce about 25 million pounds of dried pyrethrum flowers per annum, was almost the sole supplier. Pyrethrum is also grown in large quantities in the highlands of Kenya, East Africa. Pyrethrin sprays and anti-mosquito creams containing pyrethrin have given remarkable protection against malaria to the men engaged in fighting in malaria infested jungle areas. There has been great shortage of pyrethrum from the commencement of hostilities against Japan. Kenya, which became the only source of supply for the allied nations was not able to meet all the requirements. The Government of India took active steps to import seeds from Kenya and encourage plantations in suitable mountaineous regions in Kashmir, Madras and the Punjab. Recently, Pyrethrum has also been grown in the Khasi Hills in Assam and in Mysore. The efforts in growing pyrethrum in all these areas have been successful but so far cultivation has only been on a small scale.

56. The chemical and technical problems connected with the extraction of pyrethrin from pyrethrum are simple. The most urgent need is the rapid extension of areas under cultivation. The requirements of the country are very large and have been estimated at about 50,000 tons of dried pyrethrum flowers per annum. It will require very careful planning and intensive efforts to produce the required quantity of the flower. Immediate steps will have to be taken to make a complete survey of the areas suitable for the cultivation of pyrethrum and arrangements have to be made to collect the right variety of seed and start plantation in these areas. A commercial company has recently been floated with an authorised capital of 25 lakhs of rupees to acquire some pyrethrum estates in the Khasi hills and to exploit production of pyrothrin. It seems advisable that such commercial ventures should be encouraged, although it will be necessary to exercise control so that the products manufactured are up to a definite specified standard.

57. *Emetin.*—(Target of production 2,000 lbs. per annum.) The alkaloid emetin is the active principle derived from Ipecacuanha root. Ipecac plant is not native of India, but attempt has been made by the Government since 1916 to introduce the cultivation of this plant. In the Darjeeling District and in

the Nilgiris the plant has been growing successfully. A five year plan for the expansion of the cultivation of Ipecac has been undertaken by the Bengal Government. This is not adequate to meet the entire requirements of the country. Medical surveys have estiblished that there is a very wide prevalence of amoebic dysentery in this country. It has been estimated that as many as 10% of the population *i.e.*, about 40 million people suffer from amœbic infections. Emetin is a very effective destructive agent against amœba and has proved to be of greatest value in the treatment of amoebic dysentery.

58. The present production of ipecac roots is about 1500 lbs. per annum. This is able to yield about 18—19 lbs. of emetin which is enough for the treatment of about 25 thousand cases. Actually emetin is not commercially manufactured at all in the country. It has been prepared in the laboratory, but commercial production of the drug has not been started yet. Practically the whole of emetin used is imported from abroad and it is only put in ampoules and containers by the drug manufacturing firms. If ipecacuanha is available in adequate quantities there is no doubt that it will be possible to manufacture emetin in the country, as there is no special technical difficulty in its preparation from ipecacuanha roots.

59. It is essential that the cultivation of ipecac should be greatly increased at a very early date. The plant takes about three years to mature. For the treatment of 2½ million people about 15 million grains or approximately 2150 lbs. of emetin is necessary. On the basis of recovery of 1·25 lbs. of emetin from 100 lbs. of the root this will require the production of about 172,000 pounds of ipecacuanha root and will mean over 100 fold extension of the present cultivation of ipecac. It is believed by competent authorities that there are vast areas in this country suitable for the cultivation of ipecac and that the required quantity of the plant could be grown. Careful planning of the areas in which the plant could be grown should be prepared and immediate action taken to implement the plan of expanding the cultivation of ipecac on an extensive scale. The suffering of the people and the economic loss to the country on account of the prevalence of amoebic infections is very large. At least 200 million working days are lost every year resulting in a loss of 5 crores of rupees at the lowest computation.

60. *Strychnine*.—(Target of production 16,000 lbs. per annum) Strychnine is obtained from Nux-Vomica seeds. The average yield of strychnine is about 1·5%. About 1,060,000 lbs. of Nux Vomica seeds per annum will thus be required for the production of 16,000 lbs. of Strychnine.

61. Nux Vomica is chiefly grown in Orissa. Its cultivation could, however, be developed in other parts of India. The present production of strychnine in the country is nearly 15,000 lbs. per annum. It is chiefly exported to Australia for destruction of wild rabbits. The domestic consumption is only about 200 pounds. Export of strychnine in pre-war years was controlled by the international strychnine cartel which operated from outside India. The export quota allotted to India before the war was very limited. The quality of strychnine produced in India has been good; hence the arbitrary fixation of low quota from abroad should be resisted. Transport charges of Nux-Vomica seeds are at present too high: these should be lowered.

62. *Santonin.*—(Target of production 3,000 lbs. per annum.) Santonin is produced from Artomesia, cultivation of which in Kashmir has been successful.

On account of widespread prevalence of helminthic infections there is great need for santonin in India. There is also a considerable export demand. The quality of santonin produced in India from artemesia has been good. Present production is about 2 to 3 thousand pounds per annum.

63. *Ephedrine.*—(Target of production 5,000 lbs. per annum.) Ephedrine is prepared from a species of Ephedra herb indigenous to this country. The alkaloid contained in the herb varies from 0·5 to 1%. Taking the approximate average yield of 0·75% of Ephedrine, the annual requirement of Ephedra herb for the production of 5,000 lbs. Ephedrine will be about 670,000 lbs. India now produces about 3,000 lbs. of Ephedrine per annum. The quality of Indian Ephedrine has been satisfactory.

64. *Caffeine.*— (Target of production 30,000 lbs. per annum.) Caffeine is prepared from Tea waste available in very large quantities in this country. Taking an average yield of about 2% caffeine from tea waste, the quantity of the latter required for the production of 30,000 lbs. of caffeine will be 1,500,000 lbs.

65. A large quantity of tea dust used to be exported from India before the war. At present about 20 thousand pounds of caffeine are produced in India from tea dust. The quality of caffeine is satisfactory. A factory for the preparation of crude caffeine has now been set up in the tea gardens area in Assam. The crude product is refined in Calcutta.

66. *Morphine & Codeine (targets of production : morphine 3000 lbs. per annum ; Codeine 1500 lbs. per annum).*— Opium alkoloids are produced in India only at the Government Alkaloid Works, Ghazipur, and issues therefrom are made on the production of Provincial Excise permits to be obtained by the purchasers to meet their legitimate requirements.

Before the second World War, the average (1935-39) production of morphine and its salts at the Alkaloid Works, Ghazipur, was 1,100 lbs. and that of codeine and its salts 200 lbs. per annum. During the war, the demand for the opium alkaloids very greatly increased from the trade and the Government both for civil and military purposes. It was also decided to meet the war demands of the Eastern Group countries. Although the production of morphine was nearly doubled at Ghazipur and the quantity of codeine produced in 1943 was 424 lbs. (the average production of codeine during the war years 1940-44 *viz.* 207 lbs. did not however show any appreciable increase over the pre-war years production) there was much difficulty in meeting the trade demands and the pharmaceutical concerns in the country making preparations containing morphine and codeine could not for some time obtain the required quantities of opium alkaloids from the Alkaloid Works, Ghazipur.

As a result of the difficulty experienced by the Alkaloid Works, Ghazipur in meeting the abnormal demands, it was decided to expand the alkaloid manufacturing section in 1941. A new plant was accordingly ordered and installed which, however, due to various unavoidable factors, could not work in full swing until the present year *i.e.* till after the end of the war. As a consequence,

the plant did not fulfil its original purpose of supplying India's war-time needs of opium alkaloids. Its potential output is 8,000 lbs. per annum which is more than ample for peace-time requirements and it is hoped that the pharmaceutical trade will have no difficulty hereafter in obtaining the requisite quantities. At present owing to low demands, full capacity of the plant is not being utilised.

The Panel recommends that Morphine may be released more liberally to firms of repute in the country engaged in the manufacture of ethical pharmaceutical preparations.

A note by Mr. M. B. Amin on ' Galenicals and Alkaloids ' and a supplementary note by Mr. Adhikari may be seen in Appendices 1(*a*) and 1(*b*).

67. *Synthetic Chemicals.*— Treatment of diseases has for a long time been purely symptomatic. In recent years however advance in the Science of Synthetic Chemistry has placed very specific chemicals for treatment of infectious diseases. One of the most important advances in this direction has been the discovery of Sulpha drugs, and anti-malarials like Atebrine (Mepacrine). These Synthetic drugs alone with anti-biotics, like penicillin and streptomycine can combat 3/4ths of all major illnesses that occur in the country. These drugs thus constitute the most important group of drugs available for treatment of disease and must receive the most earnest attention.

68. *Sulpha drugs* :—One of the most important advances in medical science in recent years in the treatment of infectious diseases has been the introduction of sulphanilamide and related drugs in the treatment of infective conditions. Sulphanilamide was first synthesised in 1908 and had been used in the preparation of dyestuffs. In 1935 in the course of a study of the anti-bacterial activity of a group of azo dyes derived from p-aminobenzenesulphonamide it was discovered that the effectiveness resided in the sulphonamide part of the molecule. This happy observation on the part of French investigators led to the adoption of sulphanilamide in medicine. Unlike other bactericidal compounds which cannot be used internally on account of their poisonous effects on the human body sulphanilamide and its derivatives could be taken internally for the purpose of destroying the invading bacteria without the production of severe toxic symptoms in the patient.

The discovery of Sulpha drugs has provided medical men with an instrument of inestimable value in the fight against bacterial diseases. In the treatment of some of the deadly epidemic diseases which rage in India the drugs have proved extremely useful. It is essential that Sulpha drugs should be produced in the country on a large scale and made available at the lowest possible cost for the treatment of the poor.

69. Thousands of derivatives of sulphanilamide have been produced in recent years but the most important are the following, the production of which should be undertaken on a large scale in the country as indicated below :—

Sulphanilamide	100,000 lbs. per annum.
Sulphathiazole	1000.000 ,, ,, ,,
Sulphadiazine	150,000 ,, ,, ,,
Sulphamethazine	100,000 ,, ,, ,,
Sulphaphthalidine	50,000 ,, ,, ,,

A note on the manufacture of Sulpha drugs in India by Dr. Ganapati and Sir S. S. Sokhey may be seen in appendix II. In it the chemicals and equipments required for the manufacture of 500,000 lbs. of Sulpha drugs per annum have been stated and the immediate steps necessary for producing the drug have been outlined.

70. *Mepacrine.*—(Target of production 160,000 lbs. per annum.) In recent years synthetic chemistry has provided us with certain drugs which could act as substitutes for quinine in combating malaria. The most important of these is mepacrine. Calculating on the basis of about 25 grains of mepacrine required for the treatment of each case of malaria, about 350 thousand pounds of mepacrine will be needed for the treatment of 100 million cases. As a partial substitute for quinine it should be our aim to produce 160 thousand pounds of this drug per annum. The great advantage with mepacrine is that it is prepared synthetically and its production is not limited by such factors as delay in plantation and slow growth of plants as in the case of quinine.

71. The synthetic production of mepacrine is rather complicated. It is synthesised from several components, some of which are readily available in the country whilst others are at present not produced and have to be imported. Small quantities of the drug have already been prepared in the Haffkine Institute, Bombay, and by some of the commercial firms. Energetic measures will have to be taken for greatly increased production of mepacrine. The chemicals needed for its preparation should as far as possible be made in the country, though at the beginning it may be necessary to import some of these from abroad. A note by Dr. K. Ganapati and Sir S. S. Sokhey on the manufacture of mepacrine may be seen in appendix III. In it a scheme for the preparation of 500,000 lbs. of the drug per annum has been outlined. The chemicals and equipments needed and their quantities have been stated and the measures required to attain the required production of the drug have been indicated.

In recent months very great success has been claimed in the treatment of Malaria by the use of new synthetic drugs such as Paludrine and S. N. 7618 (7-chloro-4-diethylamine-methylamine butyl quinoline). Steps should also be taken to manufacture these drugs in India.

72. *DDT.*—(Target of production 30,000 tons per annum.) DDT is an abbreviation of the name of the chemical compound-pp' dichlorodiphenyl-WW'W " trichloroethane. It was synthesised as early as 1874, but its remarkable properties as an insecticide were not discovered till the World War II called for an effective insecticide. The important feature of this insecticide is its persistent action by virtue of which it remains effective over an unusually long period of time unattained by any other insecticide so far developed. For spraying over fields and marshy lands DDT has thus proved exceedingly useful. DDT is effective in low dilution. It is used both in sprays and in the preparation of dusting powders. The manufacture of DDT does not present a difficult chemical problem. Several firms have produced the article on a small scale. What is of vital importance is that the raw materials Benzene, chlorine and alcohol required for its production should be available, cheaply and in sufficient quantities.

73. It will be necessary to increase the production of benzene from the distillation of coal and increase the production of chlorine. The Panel on Sugar, Alcohol etc., has already recommended a very large increase in the production of absolute alcohol. When these three substances are available in required quantities it should be possible for India to be self-sufficient in her requirements of DDT. Efforts for the production of DDT should go hand in hand with arrangements for the rapid extension of acreage under pyrethrum. DDT and pyrethrum would be invaluable, not only in the destruction of malaria carrying mosquitoes, but will be of tremendous help in the eradication of innumerable insect pests with which the country is infested.

74. *p-Carbaminophenyl Arsonic Acid* (*carbarsone*).—(Target of production—25 million grammes per annum.) Side by side with the measures for the increase in the cultivation of ipecac for the manufacture of emetin, steps should be taken to increase the production of p-carbaminophenyl Arsonic Acid. This synthetic organometallic compound has been found extremely effective in the treatment of amoebic dysentery. This drug is produced in India, but the total production at present is only about a million grammes per annum. This is enough for the treatment of about 2 lakh cases. Considering that there are about 40 million sufferers in this country of varieties of disorders brought about by amoebic infection, the quantity of carbarsone produced at present is highly inadequate. If we aim at treating 5 million cases with this drug it will be necessary to increase our present production 25 times.

75. The most important raw materials needed for the preparation of p-carbaminophenyl Arsonic Acid are arsenic and aniline. The production of aniline, which is also required for the manufacture of sulpha drugs, mepacrine and various other substances, must be increased markedly at an early date. Efforts should also be directed to the location of a suitable indigenous source of arsenic. At present there is a definite shortage of this commodity and it may be necessary to have recourse to the importation of arsenic from abroad at the beginning. The panel recommends that necessary steps should be taken to increase the production of quinoline derivatives such as chiniofonum, di-iodoquin etc, which have been fonnd effective in the treatment of amoebic infections already there are being manufactured on a small scale.

76. *Sulpharsphenamine and Neo-arsphenamine* : (Target of production 25 million grammes per annum.) It is considered that for a considerable time to come the demand for these well tried arsenical preparations will remain high and a production of 25 million grammes per annum of these drugs in the country should be achieved. The main difficulty in this regard will be same as in the preparation of Carbarsene, namely the availability of arsenic. This will have to be imported from abroad till suitable indigenous source of arsenic could be found.

77. *Anti-Biotics.*—Penicillin and Streptomycin are amongst the most important drugs in the treatment of bacterial infections. They more or less cover the same field as the sulpha drugs. So the question arises whether the antibiotics would completely displace the sulpha drugs. The answer is definite.

From the therapeutic point of view, Penicillin is an effective supplement, but not a substitute for the sulpha drugs. The modes of action of these two

classes of drugs are dissimilar and their spectra of therapeutic activity are not exactly the same though they overlap in certain regions. Actually, in the antibiotics we are ordinarily looking to cover the regions where the Sulpha drugs are of no use. Further the Sulpha drugs, unlike Penicillin and other biological products are very stable, and can be stored almost indefinitely. Because of this property, sulpha drugs will be the drugs of choice for use in the rural areas of India. The use of Penicillin will be limited for long to urban areas.

78. *Penicillin.*—(Target of production one million million units per annum.) Penicillin is effective against a number of deadly bacteria resistant to sulphonamides. Unlike sulphonamides its antibacterial action is in no way diminished by blood, pus, and tissue fluids. Its chief value lies in the fact that it is absolutely non-toxic to human tissues, even at high concentrations, while its inhibitary action is exerted in extremely dilute solutions.

79. It has not yet been possible to prepare penicillin synthetically. The only known way in which it is produced at present is by the activity of a mould belonging to the species of penicillium. The chief difficulty connected with its manufacture is that the mould is capable of producing it only in infinitesimal quantities. From the culture medium, penicillin has to be concentrated nearly a hundred thousand times for preparing it in a form suitable for injections. The unstable nature of penicillin towards heat, acids, alkalies, heavy metals and many common laboratory re-agents, makes its production extremely complicated. There are two methods of production of penicillin which are commercially practised. The first is the surface culture method, where the mould is grown in shallow layers of nutrient media in bottles ; the second is the submerged culture method where the growth takes place in huge vessels of liquid media. The second method is now generally employed for large scale production of penicillin, as it is far more economical in labour and in material. Large deep tanks are used as fermenters which have to be kept under a septic condition. The sterility of the media should be absolute. Even a few stray bacteria left in are enough to spoil the broth. A very large volume of absolutely sterile air has to be delivered to the fermenters for the mould to respire.

80. The difficulties of manufacture of penicillin have now been gradually conquered and large quantities of the drug are being produced in U.K., U.S.A. and Canada. The production of penicillin in U.S.A has increased from 425 million units per month in June 1943 to 460,000 million units per month in March 1945. With this thousand fold increase in the production of penicillin, the cost of manufacture has also been brought down considerably. In the two years between 1943 and 1945 the price of penicillin has dropped from $20 to less than $2 per 100,000 units. A note by Dr. K. Ganapati and Sir S. S. Sokhey may be seen in Appendix IV ; in it the chemicals and equipments necessary and the measures required for effecting large scale production of penicillin have been described.

81. The need for penicillin in India is very great and it is essential to start its production on a very large scale. The cost of production should be the lowest possible and no profit motive should enter into the scheme. The

Panel recommends that the production should be undertaken at first as a State enterprise. The same remarks apply to sulpha drugs and mepacrine. All these three vitally important groups of drugs should be manufactured under the control and management of the State. Qualified scientists should be sent abroad to get acquainted with the latest techniques of manufacture and the production should be taken in hand at the earliest possible date.

82. *Vitamins.*—They are present in natural food and a well balanced diet should provide all the necessary vitamins. A wide variety of food-stuffs such as green leafy vegetables, fruits and milk are essential features of a well balanced diet. Widespread malnutrition prevails in the country at present because of lack of both quantity and the right quality of food. While the problem of increasing the quantity of food available to the people is at present receiving serious attention of the Government, the production of vitamins should be taken in hand to combat the qualitative deficiency in the diet of the people. In addition vitamins are used as drugs in the treatment of diseases.

83. *Vitamins D, E and K.*—Vitamins E and K are present widely in different articles consumed as food. So there is little likelihood of shortage of these vitamins. Vitamin D is formed naturally by the action of sunlight on the skin. In a country such as India where there is no dearth of sunshine the danger of deficiency of vitamin D is not very great except in such persons, who on account of social customs or habits spend the whole of their time indoors, shut away from the light. Hence, the production mainly of vitamins A, C and vitamins of B group need be considered here, but a certain quantity of vitamin D (calciferol) should also be produced in the country. We understand that the Technical and Planning Panels of the Food Department are considering this question.

84. *Vitamin A.*—(Target of production 1,000,000 gallons of shark liver oil of potency 6,000 units per gramme) Shark-liver oil industry has assumed great importance in recent years. Shark-liver oil is a very rich source of vitamin A. So far, the medical world has depended on cod-liver oil, but shark-liver oil is much richer in its content of vitamin A than cod-liver oil. Good samples of shark-liver oil are, on an average, 10 times as potent as cod-liver oil. Some samples are even 100 times as potent. Indian waters abound in shark. There is thus a basis for a valuable industry of the greatest importance to the country.

85. Vitamin A is one of the most important vitamins and it plays a significant role in the nutrition of the children and adults. Deficiency of this vitamin retards growth, causes night blindness, and lowers the general resistance towards infection. If children do not get adequate quantities of it, they remain ill-developed.

86. Normally, children and adults the world over get their requirements of vitamin A from milk. But milk is scarce in India with the result that Indian manhood is ill-developed. This, coupled with the critical food situation prevailing in the country, is leading to a great deal of sickness and ill-health. In countries like America, where milk is plentiful, the stature of

the European populations that have migrated to America has shown a significant increase in height. In India the trend is in the reverse direction because of the inadequate quantities of milk available to the people. This grave shortage can be ameliorated to a certain extent, in so far as vitamin A is concerned, by making available plentiful supplies of shark liver oil.

87. At present the industry is very haphazardly organized. The Fisheries Departments of some maritime provinces and some private agencies are engaged in the production of shark-liver oil. But no one, as far as we know is conducting the fishing of shark or the extraction of oil on any scientific basis. Fishing is usually done indiscriminately by fishermen with the means at their disposal which are not adequate for the purpose. Extraction of the oil is done under quite primitive conditions and the oil loses a considerable amount of its potency and acquires a very unpleasant taste and odour. The panel feels that urgent steps should be taken to put the industry on a better basis. First the fishing should be properly organised under the scientific control of the various Fisheries Departments and secondly for the processing of livers suitable factories, equipped with modern appliances, should be provided.

88. Though the need of the country is great, there are no adequate organisations for making the oil available to the people who need it, and although the amount of oil produced at present is far below the country's actual needs yet even the small amounts of oil that are being produced are not finding a market. The Fisheries Departments have actually been forced to curtail production. Coupled with this is the uncontrolled sale of spurious shark-liver oil products by private agencies. Shark-liver oil is a new product and if people, by using spurious preparations, come to form an opinion that shark-liver oil is not as good as cod-liver oil, the industry would be damaged beyond repair.

89. To remedy the situation, three steps require to be taken almost immediately. First the work of the Fisheries Departments of the various Governments should be co-ordinated to put the fishing of sharks and the production of oil on sound scientific lines. Secondly, the Food Departments of the various Governments should make available to the people, either free or at a nominal cost, this most important source of vitamin A. A great deal of propaganda may be necessary to get people used to this product. Thirdly, the Drugs Act should be brought into force, as soon as possible to prevent the manufacture and sale of spurious products.

90. With this object in view, the panel adopted the following resolution :—

" In view of the extreme importance of vitamin " A " in the nutrition of the people, the demonstrated lack of it in the diet of the vast majority of the people of India causing extensive ill-health and the need of its being fed as a routine measure, particularly to the vulnerable groups of the population, the Panel recommends that the Government of India do set up as early as possible a Central Board representing the relevant Departments of the Government of India, the Departments of Fisheries of the different maritime Provinces and non-official experts. This Board should be advisory in capacity. It

should be provided with a whole-time Secretary and should work out the necessary steps to put the shark-liver oil industry on a sound and permanent basis. The Board will devise methods for bringing into being suitable arrangements for the proper methods of fishing to secure adequate supply of fish for the country ; will study and fix seasons during which fishing should be carried out to safeguard the proper breeding of the fish ; will study, devise methods for bringing into being suitable processes for the extraction of oil and utilisation of by-products ; will suggest setting up of plants for the extraction of vitamin ' A ' from the oil ; will suggest standards ; will suggest the formation of a Marketing Board and devise ways and means for making available to the people oil of standard quality and vitamin ' A ' concentrates. The Board will also recommend means for securing adequate standard of wages for workers in the industry which will secure their general well-being ".

91. We understand that the Technical and Planning Panels of the Food Department are considering the targets of production of Vitamin A concentrates and planning for their production. In this connection reference may be made to Appendices VI and VII where the question of manufacture and use of shark liver oil and Vitamin A concentrates has been discussed.

92. *Vitamin B (complex)* consists of several vitamins ; vitamin B1 or thiamin, vitamin B2 or riboflavin, nicotinic acid, etc. The deficiency of this vitamin is most common in Indian dietary. This is chiefly due to the dependence of the Indian people on cereals such as rice, which is highly polished, and wheat, which is highly milled, and the absence of articles such as meat, milk, egg-yolk, green vegetables etc., in the diet. One method of meeting this deficiency of vitamin B would be to introduce yeast in the dietary. Yeast is a cheap and concentrated form of vitamin B (complex) as well as of high class protein. The Food Department is giving special consideration to the question of large scale production of yeast in the country. The production of pure vitamins of B group, particularly thiamin, riboflavin and nicotinic acid, should be undertaken. We understand that the Technical and Planning Panels of the Food Department are fixing targets for these vitamins and planning for their production. We would recommend that such plans of production should be integrated with the schemes of production of fine-chemicals.

93. *Vitamin C.*—Vitamin C is present in fresh citrous fruits such as oranges, lemons, other fresh fruits and fresh vegetables. Gross deficiency of this vitamin leads to scurvy, but partial deficiency leads to ill-health and lower resistence to diseases. Dried Amla powder has been used in this country as a source of Vitamin C. Ascorbic acid or vitamin C is, however, now made synthetically in most countries. The synthetic preparation of this article is not chemically difficult and it could be made in this country. The need of vitamin C for an adult is about 75 milligrammes per day. Gross deficiency of this vitamin is not so common in this country as that of vitamins A and B, but a large section of the population suffers from partial deprivation of this vitamin. The needs of about 2 million people for a daily supplement of 25 milligramme of vitamin C could be provided by the production of roughly 100 lbs. of ascorbic acid per day. We understand that the Technical and Planning Panels of the Food

Department are fixing targets for the production of this vitamin and we recommend that the plan of production should be integrated with the plan of production of fine chemicals.

94. FINE CHEMICALS AND SOLVENTS—The development of the manufacture of fine chemicals and solvents on a large scale in the country is absolutely essential for the establishment of the drugs and pharmaceutical industries as well as for the plastics, rubber and other industries. So far very little progress has been made in this direction. The fine chemicals industry is dependent on the development of the heavy chemical industry and the availability of adequate quantities of basic and intermediate chemicals and solvents. The suggestions of the Panel regarding the targets of production of different Fine Chemicals and Solvents are given in paragraph 40. During the war, two large Government plants for the manufacture of Benzene have been set up at Jamshedpur and Hirapur. When the projects for the contemplated large increase in the production of steel are put into operation it will be possible to set up similar large plants for the increased manufacture of Benzene to meet the rapidly growing needs of the drugs, fine chemicals and other industries for Benzene. The Panel on Sugar, Alcohol and Food Yeast has recommended production of very large quantities of absolute alcohol in the country. With the introduction of the scheme, it is believed cheap alcohol would be available to the fine chemicals industry. Two notes by Dr. J. N. Ray on fine chemicals and solvents may be seen in appendices VIII and IX. The developments of the heavy chemical industry, dye industry and the fine chemical and drug industry must necessarily go together and more and more of these should be manufactured until the country becomes self-sufficient in all these fields. Materials and talents are available in the country. What is needed is a well integrated plan executed with vigour. The fine chemicals industry in India to-day suffers from lack of equipments. The chief chemicals operations involved in the preparation of fine chemicals are not many and known to the existing manufacturers. There are however some important respects in which Indian manufacturers have not been up to the modern practices obtained abroad viz., in the application of electrochemical and high pressure technique. In these important respects the deficiency of India will have to be made good.

95. PHOTOGRAPHIC CHEMICALS—The only photographic chemicals manufactured in appreciable quantities in India at present are Sodium Hypo Sulphite (Hypo), Sodium Sulphite and Sodium bi-sulphite.

The present annual production capacities for the chemicals are roughly as follows :

Hypo	900 tons.
Sodium Sulphite	300 tons.
Sodium bi-sulphite	300 tons.

The present requirements in India per annum are about 500 to 600 tons Hypo, 150 tons Sodium Sulphite and 400 to 500 tons Sodium Bi-Sulphite. 80% of these chemicals is used by the film industry. It is believed that the demand would increase by 100% within the next 10 years.

96. There is a considerable demand also for Chrome Alum—about 700 to 800 tons per annum. Some amount of Chrome Alum is now being produced in Bombay. There is no production at all of developing agents such as Hydroquinone, Rhodinel etc. The weakness of the Indian Industry in photographic chemicals lies in this. Production of developers should be started in this country. The targets of production of photographic chemicals are given in paragraph 40.

97. EQUIPMENT AND MACHINERY.—Lack of proper equipments and machinery has been a great handicap in the development of the industry. For the large scale production of fine chemicals and drugs, it is necessary to have in the country engineering firms capable of making modern plants and appliances. Due to the high standard of purity required in the manufacture of drugs and fine chemicals, corrosion resistant vessels have to be employed in a great number of operations. These vessels should be acid and alkali resistant and consist of enamelled, porcelain, glass and rubber lined stills, kettles and pots, or vessels made of stainless steel, monel, inconel, etc. None of these are now made in India. While attempts should be made to manufacture special alloys such as stainless steel, monel, inconel, etc., and for making enamelled, glass and rubber lined vessels in the country, it will be necessary to import these materials from abroad for some time, in order not to hold up the expansion of the fine chemicals and drugs industry.

98. Many of the processes involved in the manufacture of fine chemicals and drugs represent but a large scale laboratory experiment and large glass flasks, retorts, condensers etc., are employed. Glass apparatus of all kinds and equipments such as percolators, concentration pans, filter presses, centrifugals, distillation columns, incubators, ovens and simple autoclaves have been fabricated in the country in small quantities under proper supervision. There is however, no firm in India at present capable of executing large orders for such equipments. It will take some time for the manufacture of machinery and equipments of all kinds to be developed on a large scale, so the supply is likely to lag behind the demand. In order to stimulate the development of the manufacture of fine chemicals and drugs, it will be necessary in the beginning to import equipments that are urgently required. At the same time, efforts should, of course, be made to develop the production of machinery in this country. Two notes by Mr. N. Adhikari on the subject of machinery and equipments may be seen in Appendices XI (*a*) and XI (*b*).

99. GENERAL QUESTIONS OF POLICY—In the opinion of the Panel India should attain self-sufficiency with regard to fine chemicals, drugs and pharmaceuticals within the next 15 years. In order to achieve this, it will be necessary to expand the coal distillation industry. India at present has a production capacity of about two million gallons of Benzene and half a million gallons of Toluene per annum. It is necessary that the plants producing Benzene and Toluene should be kept in full operation. With the large amount of Benzene and Toluene available, it will be possible to produce such intermediates as Phenol, Aniline etc., which would form a suitable starting point for the manufacture of fine chemicals, synthetic

and allied products. We presume that the Panel on Heavy Chemicals has considered the desirability of making the heavy chemicals required for the development of the industry available to the manufacturers at a reasonable price.

100. *Management of Industry.*—Large quantities of Benzene and Toluene are being produced in Government plants. This production should be continued and further extend-ed. It is also absolutely necessary that the production of coal tar intermediates should be developed. At the present moment no firms are producing these in India. The State should initiate the production of these themselves and/or through private enterprise if possible. Many industries are handicapped at the present moment, because of the non-availability of aniline, phenol, chloro-benzene, etc. It is necessary that these should be made easily and cheaply available, if our targets of production of various drugs and chemicals are to fructify. In the case of the manufacture of new and vitally important drugs such as Penicillin, streptomycine, mepacrine, sulpha drugs etc., the State should take the initiative and should take up production and at least put up the first plants to serve as models and to train up personnel. As regards other products we are dealing, in view of what we state in paras. below, we are not in a position to indicate here what type of management should be employed for their production, which will depend on the decision taken on all the different fields.

101. *State Aids.*—The State should take up initiative with a view to help industry and set up pilot plants where necessary. Production should be started wherever necessary with imported basic and intermediate materials.

102. The Nascent industries will have to be protected. The exact method by which this can be achieved would depend on the industry concerned.

103. Research on fundamental problems connected with the manufacture of fine chemicals, drugs and pharmaceuticals in the country should be liberally subsidized by the Government. Certain experts may have to be provided by the Government to advise industries on specific problems connected with the production.

104. *Training of technical personnel.*—The training of scientific and technical personnel for the development of industry is a subject that should have our closest attention. We have paid considerable attention to this and are of the opinion that we must first decide on the projects we want to undertake in the country. We should then look for the likely men in the country who can undertake that work either because they are actually engaged in it or have the basic training which would be of value for carrying through that project. Such men should be formed into teams and each one allotted a specific place in the development of that project. Once such teams are formed we may even start developing the project itself and in the working of it we may find that the men need training abroad to fill gaps in their existing knowledge and experience. They will then go abroad with specific duties in the project allotted to them and they will thus be studying preselected problems, to enable them to competently take part in the work of the team. Such training will have meaning and purpose. The present practice of sending individuals abroad for

studying wide subjects cannot yield any practical results. The full value of training can be derived only if well-trained men are sent abroad to specialise in specifically selected portions of a project. Thus a number of men would complement one another's knowledge and make a well-trained team to cover the whole project. The government should arrange that suitably qualified university graduates may receive practical training in the manufacture of fine chemicals and pharmaceuticals in the manufacturing con erns in India.

105. *Foreign capital.*—While the Panel considers that it will be preferable to be independent of foreign capital and management, it is felt that this question will have to be considered on the merits of each case. Where it is necessary to depart from this principle, certain measures for safeguarding the interests of the country should be adopted.

106. *Location of Industry.*—In the opinion of the Panel, the industries should be located primarily on the consideration of availability of raw materials, labour, consumption and distribution facilities in relation to other industries.

107 *Association of Industries* —It is felt that associations of industries would be of considerable help in the development of new industries, but in the opinion of the Panel cartels are definitely undesirable. Every encouragement should be given for the expansion of each group of industries.

108. *Customs Duty.*—The Customs duty on raw-materials and semi-manufactured goods required for the industry should be remitted for the first 5 years and the duty on finished materials should be increased gradually as soon as manufacture begins to develop. Capital goods* required for the industry should be allowed to be imported free of duty for the first ten years.

109. *Railway Freights.*—The present railway freights on raw material and finished goods are extremely high and act as deterrent to the development of the Fine Chemicals and Drugs Industry. The Railway rates should be revised and brought down.

110. *Excise Policy.*—A uniform excise policy should be adopted throughout the country and local variations in excise rates should be abolished. The excise duty on spirituous, medicinal and other preparations in all Provinces and States should be uniform. Indian made spirituous preparations should have the same facility of movement from one part of the country to another as imported spirituous preparations, when once the duty has been paid at the place of manufacture.

For the manufacture of fine chemicals and drugs where sugar is used as a basic raw material, the present excise duty on sugar should not be levied.

111. *Export.*—There is definitely scope for export and attempts should be made to make full use of the export markets. Exports should be encouraged without any prejudice to the needs and interests of the country.

112. *Suggestions as to the stages by which the fine Chemicals and Drugs Industry is to be developed.*—We should have liked to have been in a position to indicate a programme for the development of the fine chemicals and drugs industry in the country.

* Plants, machinery, laboratory apparatus, etc., as required by the Fine Chemicals and Pharmaceuticals Industry.

The proper development of this industry, leading to self-sufficiency, requires a well-balanced and integrated plan for the production of heavy chemicals, coal distillation products, organic solvents (produced by fermentation and synthetic processes) and the intermediates manufactured from the former. Then again, the production of these starting materials has to be linked up not only with the needs of the drugs and fine chemicals industry but also with those of the dye-stuff, artificial fibre, plastic and synthetic rubber industries and production of Vitamins as suggested by the Technical and Planning Panels of the Food Department, which also require many of the same basic materials. A programme of production, thus, can be drawn up only by integrating the reports of the panels dealing with the planning and production of the above-mentioned raw materials and finished products. This panel is not in a position to draw up the needed programme in a very concrete way. The Panel recommends that the Government should now set up a Technical Planning commission to prepare concrete and detailed plans for the development of each of these industries and finding ways and means of implementing these plans.

113. We should, however, like to discuss here an equally important question regarding drugs and fine chemicals manufacture, whether the production of the raw materials or the drugs should be taken up first. It is often suggested that we should begin with the production of basic materials and make the country self-sufficient in them before we take up the manufacture of drugs and fine chemicals. A moment's reflection will, however, tell that to defer undertaking the manufacture of the drugs until the production of the basic chemicals has been established in the country is not a practical proposition. The manufacture of basic materials and drugs must go side by side. The production of some basic chemicals can be taken up immediately, while that of others has to wait on the development of resources. In the very nature of things, it will take a considerable time before the country becomes self-sufficient in all the basic materials. The practical way to establish the industry is to decide upon the minimum number of drugs and fine chemicals essential for the country. We should start with the production of these drugs, utilising the raw materials already available in the country and importing others not so available. This will have two desirable effects. First, this procedure will provide the country with a supply of the essential drugs from the very start and at prices which will compare favourably with those of the imported drugs. Secondly, this is equally important, it will create a demand for the basic chemicals and thus give an impetus to their production in the country. As the production of the essential drugs and fine chemicals proceeds, we should be developing the manufacture of the basic materials required. We should aim at self-sufficiency in a period of 15 years both as regards the raw chemicals and finished products. Therefore, we definitely suggest that the production of essential drugs should not wait on the production of basic chemicals in the country, but we should start with the manufacture of essential drugs and import the raw materials not available here till we develop our resources.

114. Consonant with the policy indicated above, the manufacture of two types of drugs should be taken up immediately, namely (1) those which are essential for guarding the health of the public and warding off infectious diseases

and (2) those for which India already has, or can easily develop, raw materials in abundance. Under the first category come the sulpha drugs, antimalarials (quinine, mepacrine and pamaquine), penicillin and streptomycin. The arsenicals and D.D.T. can also be included in this list. The manufacture of these drugs should be taken up immediately. The Panel recommends that Government should take up the initiative and put up the first plants which should serve as models. These drugs are needed by the poorest of the poor ; they must be made available to the health authorities, Government hospitals and the public at the lowest possible cost. In the second group come drugs of vegetable origin. The production of the drugs from vegetable sources such as quinine, emetine, morphine, caffeine, ephedrine, santonin, essential oils, etc., should be developed to the fullest possible both for the needs of the country and also for export. These drugs are literally to be treated as wealth of the country to be developed as such. We should also include in this group the biologicals, vaccines and sera, liver extracts, glandular products etc. These are being produced in the country and their production should be improved and increased as demand for them increases. Insulin has yet to be produced in India on a commercial scale and its production should be taken up. The development of shark-liver oil industry requires a mention by itself. In shark-liver oil we have a much richer source of vitamin A than in cod-liver oil. Shark is abundant in Indian waters. This industry should be specially developed. In connection with this the panel is of opinion that a central board representing the relevant Departments of the Government of India, the department of fisheries of the different maritime provinces and non-official experts with a whole time executive should be formed to take the necessary steps to put the Shark-liver oil industry on a firm and permanent basis as explanied in paras. 89 and 90.

115. Along with the manufacture of drugs and fine chemicals, largely from imported material, we shall have to start a planned production of heavy chemicals, solvents and intermediates. We are not giving a programme of their manufacture since this can be drawn up only by integration of the reports of a number of panels, as we have explained above. We should, however invite attention to a number of basic chemicals which are of special importance to the drugs and fine chemicals industry.

116. Among the heavy chemicals, the manufacture of three items, chloro-sulphonic acid, sodium and chlorides of phosphorus, is very important and should be taken up without delay. Of these, only chlorosulphonic acid is being produced in India but in small quantities and at prohibitive cost. This important chemical should be produced at a price that can compete favourably with the imported material. For the manufacture of sulpha drugs alone about 1500 tons of this material will be required per annum.

117. The production of intermediates from coal distillation products such as aniline, acetanilide, chlorobenzene, phenol, diethylaniline, para anisidine para nitrotoluone, phthalic acid and anhydride etc., requiresi mediate attention. During the war, for defence requirements, plants were installed by the

Government of India for the manufacture of distillation products of coal. Consequently, India has now a production capacity of about two million gallons of benzene and half a million gallons of toluene. These are no longer required for defence purposes, and are now available for the industrial development of the country. The production of these should be kept up and they must be utilised for the manufacture of the intermediates mentioned above. Special efforts should be made to produce refined 2° pyridine which is essential for the manufacture of sulpha drugs.

118. Among the solvents, India produces ethyl alcohol in good quantities at competitive prices. Acetone is being produced at one of the Ordnance Factories from ethyl alcohol. Since the explosives are not now manufactured, there is no use for the acetone in the Ordnance Factory. If the production of acetone in this factory is kept up, the needs of the drug industry will be met to a great extent. Immediate arrangements should be made for the manufacture of the other solvents, acetic acid, butyl and amyl alcohols in the country. Special efforts should be made to manufacture ethylene oxide, a very valuable intermediate, which is difficult to import because of its low boiling point.

119. Of the remaining items, the production of three chemicals, lactose, thiourea and guanidine nitrate, are important. Lactose is used for the manufacture of penicillin. Thiourea and guanidine nitrate are essential for the manufacture of the sulpha durgs.

120. We would like to take the opportunity of stressing again the proper plan for training scientists and technicians for developing industry in the country. As stated in para. 104, the panel is of the opinion that in each case the project must be first decided upon and men selected in India to fill these projects. Each man should be allotted a specific duty in that project, in consonance with his existing knowledge and training. They should then be sent abroad for training as teams with specific duties allotted to each. The full value of training can be derived only if well-trained men are sent abroad to specialise in specifically selected portions of a project. Thus a number of men would complement one another's knowledge and make a well-trained team to cover the whole project.

SUMMARY OF RECOMMENDATIONS OF THE PANEL.

(1) *Object to be achieved.*—(*Para 7.*)—The Panel considers that it should be the object to make India self-sufficient in regard to fine chemicals, drugs and pharmaceuticals within the next 15 years. The country must produce all essential drugs and make them available for the use of the masses at economic prices.

(2) *Raw materials for the manufacture of Fine Chemicals and Drugs.*—For the production of fine chemicals and drugs on a large scale, adequate quantities of the following groups of articles should be available :

(*i*) *Inorganic chemicals*, (*Para 10*).—Basic chemicals, such as the main acids and alkalies, common inorganic sulphates and phosphates and essentia gases such as chlorine, ammonia, carbon-dioxide, hydrogen, etc. should be available in sufficient quantities and at economic prices. This question has already been dealt by the panel on heavy chemicals.

(*ii*) *Distillation products of coal*, (*Paras 11-18, 100*).—It would be necessary to develop coal distillation industry to the furthest possible extent and to place it on a sound and rational basis.

During the war the Government of India have set up two coke oven recovery units for the production of benzene and toluene at Jamshedpur and Hirapur. The plants should continue in operation. Until such time as the fine chemical industry is ready to absorb the products, they should be utilised as motor fuel.

It is absolutely necessary that the production of coal tar intermediates should be developed. At present these are not produced in India. The State should initiate the production of these items themselves and/or through private enterprise. The Fuel Research Board may be requested to consider the problem connected with the production of tar more suitable for by-product recovery from Indian coal. The coal tar intermediates for the preparation of drugs and dyes are common, and there should be close co-ordination in the plan for the development of the manufacture of dyes and drugs in this country.

(*iii*) *Wood distillation products.* (*Paras 19-21*).—Although the most important chemicals obtained from wood distillation, such as acetic acid, acetylene, methyl alcohol and formaldehyde are now produced synthetically in most countries, it is recommended that in parts of India, where there is demand for wood charcoal and suitable varieties of wood are available cheaply and in abundance, the possibility of economic production of these chemicals by distillation of wood may be further considered.

(*iv*) *Fermentation products.* (*paras 22-23*).—The fermentation industry is of the greatest importance to the country and its development should be taken in hand without delay.

(*v*) *Petroleum products*—(*Para. 24*).—It is considered that it should be possible to obtain from indigenous petroleum India's requirements for petroleum ether, liquid petroleum or white mineral oil and paraffin wax. Steps should be taken to produce required quantities of the above in the refineries in India.

(vi) Animal products—(paras. 25-29).—The present arrangements for the collection of animal tissues and glands from the slaughter houses are very unsatisfactory. The materials should be made available to the manufacturers in a fresh condition to obviate any possibility of deterioration. Quick removal of the glands, etc. after slaughter and their immediate freezing on the spot will require to be provided. Cheap transport facilitis in cold storage will also have to be arranged.

About 8,000,000 c. cs. per month of bacterial vaccines are being produced at present in Government laboratories. Besides these existing laboratories, it is recommended that all Provincial Governments should organise their own bacteriological laboratories in the near future. It is necessary that the manufacture of Agar Agar from indigenous sources should be further developed. To meet the increasing demands for anti-toxins and sera, with the increase in medical relief organisations in the country, it is recommended that all Provincial Governments should organise their laboratories.

(vii) Vegetable products (Paras 30-34).—India is very favourably situated regarding the preparation of vegetable drugs. There are wide varieties of soil and climatic conditions in which medicinal plants of all kinds can be grown. With careful cultivation, the resources of the country in this direction could be greatly increased. Steps to be taken to increase the cultivation of medicinal plants should have in view not only the requirements of the country, but also the export trade. An inquiry should be instituted into the whole question of production of these drugs on a large scale so as to improve the quality and reduce the cost and enable Indian products to meet foreign competition.

There should be a Government organisation in each Province or group of Provinces for improvement in cultivation and collection of medicinal plants. The Government should also organize stores where vegetable drugs of all kinds properly stored and graded would be available in good condition to drug manufacturers.

Plants from which important fixed and essential oils are obtained are all grown in the country. If the raw materials are properly collected, adequate quantities of oils could be produced. It will not only be sufficient for the internal demand but will leave enough for export purposes.

(viii) Synthetic chemicals (Paras. 35-39).—Synthetic chemicals industry has hardly been developed in the country. The preparation of synthetic methyl alcohol from carbon monoxide and hydrogen and of synthetic chemicals from acetylene, ethylene, etc., will have to be developed on a large scale. Synthetic production of drugs and fine chemicals from intermediates derived from the distillation products of coal such as benzene, toluene, naphthalene, anthracene also should be developed.

(3) *Difficulties hampering the development of the manufacture of Fine Chemicals and Drugs* (*paras. 41-46*)—The main difficulties are the following :—

(*i*) *Supply of raw materials* (*Para. 42*).—The basic chemicals such as the main acids and alkalies are available but the prices of these are in many cases too high. The basic chemicals should be available to the Indian manufacturers at economic prices. The manufacture of adequate quantities of solvents, crude vegetable drugs of proper quality, and intermediates from the distillation products of coal should be organised on a sufficiently large scale.

(*ii*) *Heavy cost of transport* (*Paras 43 and 109*).—The cost of transport of raw materials and finished goods from one part of the country to the other is too high at present. This is an important factor in raising up the cost of production of Indian goods and is responsible for the difficulties experienced by Indian manufacturers in facing competition from abroad. The railway freights on drugs and chemicals should be cut down to the minimum.

(*iii*) *Provincial excise rules* (*Paras. 44-45*).—The manufacturers and distributors are greatly handicapped at present owing to the existence of different excise rules in different provinces. Indian made spirituous preparations cannot be transported from one part of the country to the other without overcoming a great deal of vexatious interference. A uniform excise policy should be adopted throughout the country and local variations in excise rules should be abolished, as far as possible. The excise duty on spiritous, medicinal and other preparations in the provinces and States should be uniform. Indian made spirituous preparations should be allowed to move freely throughout the country, in the same way as imported spirituous preparations, when once the duty has been paid at the place of manufacture.

(*iv*) *Lack of control over standards* (*Paras. 46-47*).—Spurious drugs and alkaloids, and biological products below thier strengths are still being allowed to be sold with impunity. This acts prejudicially against the interests of the honest manufacturers and leads to lowering of confidence in Indian products. The Panel recommends that the Drugs Act should immediately be brought into force. The Provincial Governments should take steps to organise drug testing laboratories to implement the Act. The Pharmacy Act should also be brought into operation as early as possible.

(*v*) *Existing patent laws* (*Para. 48*).—Most of the important processes for the manufacture of drugs and fine chemicals urgently needed for the country are covered by foreign patents. Under the existing Patents Act it is practically impossible to obtain a compulsory licence from a foreign patentee. It is understood that so far there has not been a single case in India where a compulsory licence has been granted under the Patents Act. It is suggested that Sections 22 and 23 of the present Patents Act should be revised in consultation with the Controller of Patents.

(4) *Non-ethical Patent and proprietory medicines* (*para. 49*).—Immediate and drastic steps should be taken to eliminate as far as possible the trade in non-ethical patent and proprietory medicines and secret drugs, which is thriving on the ignorance and credulity of the people.

(5) *Importance of concentrationg on the manufacture of some essential drugs Paras. 50-93*).—There are certain essential drugs for which the need is very great and urgent. The Panel considers that attention should be specially concentrated on the production of the following articles of vital importance for the health and well-being of the nation in quantities as shown against each

Vegetable drugs.	Target of production in 10 years.
Quinine	2,000,000 lbs. per annum within 15 years.
Pyrethrum	50,000 tons of dried pyrethrum flowers per annum.
Emetin	2,000 lbs. per annum.
Strychnine	16,000 lbs. per annum.
Santonin	3,000 lbs. per annum.
Ephedrine	5,000 lbs. per annum.
Caffeine	30,000 lbs. per annum.
Morphine	3,000 lbs. per annum.
Synthetic drugs.—	
Sulpha drugs	500,000 lbs. per annum.
Mepacrine	160,000 lbs. per annum.
Paludrine	Target not fixed.
D. D. T.	30,000 tons per annum
P-carbaminophenyl Arsonic acid (carbarsone)	50,000 lbs. per annum.
Sulpharsphenamine and Neoarsphenamine	50,000 lbs. per annum.
Anti-biotics—	
Penicillin	1,000,000 million units per annum.
Streptomycin	As much as possible.
Vitamins—	
Vitamin A	1,000,000 gallons of shark liver oil of potency 6,000 units per gramme.
Vitamin B (group) } Vitamin C .. } Vitamin D .. }	Targets not fixed. The Technical and Planning Panels of the Food Department are dealing with this question.

(6) *Targets for fine chemicals, solvents and photographic materials* (*Para. 40*) —In addition to the items mentioned above, targets of production by the end of the next 10 years have been fixed for various other fine chemicals, drugs, solvents and photographic chemicals, which may be seen in para. 40.

(7) *Equipment and machinery—*(*Paras. 97-98*).—Glass apparatus and equipments such as percolators, concentration pans, filter presses, contrifugals distillation columns, incubators, ovens and simple autoclaves are made in the country in small quantities. Special acid and alkali resistant vessels such as enamelled, Porcelain, glass and rubber lined stills, kettles, pots, etc. and vessels made of stainless steel, monel, inconel etc. are however not made in India. While attempts should be made to manufacture such equipments in the country it will be necessary to import these materials from abroad for some time in order not to hold up the expansion of the fine chemicals and drugs industry.

(8) *General questions of policy—*(*Para. 100-111*).

(*i*) *Management of industry—*(*Para. 100*).—The Panel considers that in the manufacture of new and vitally important drugs like penicillin, streptomycin mepacrine, sulpha drugs, etc. the State should take up the initiative and should take up production and it should at least put up the first plants to serve as models and to train up personnel. The State should also initiate the production of coal tar intermediates themselves and/or through private enterprise.

(*ii*) *State aids* (*Paras. 10 to 103*).—The State should take up initiative with a view to help the industry and set up pilot plants, where necessary. Production should be started wherever necessary with imported basic and intermediate materials.

The nascent industries will have to be protected. The exact method by which this can be achieved would depend on the industry concerned.

Research on fundamental problems connected with the manufacture of fine chemicals, drugs and pharmaceuticals should be liberally subsidised by the Government. Certain experts may have to be provided by the Government to advise industries on specific problems connected with the production.

(*iii*) *Training of techincal personnel* (*Para. 104*).—Steps should be taken for training scientists and technicians for developing industry in the coutnry In each case the project must be first decided upon and men selected in India to fill these projects. Each man should be allotted a specific duty in that project in consonance with his existing knowledge and training. They should then be sent abroad for training as teams with specific duties allotted to each. The Government should arrange that suitably qualified university graduates may receive practical training in the manufatcure of fine chemicals and pharmaceuticals in the manufacturing concerns in India.

(*iv*) *Foreign capital* (*Para 105*).—While the Panel considers that it will be preferable to be independent of foreign capital and management, it is felt that this question will have to be considered on the merits of each case.

(*v*) *Location of industries* (*Para 106*).—The different units should be located primarily on the consideration of availability of raw materials, labour consumption and distribution facilities in relation to other industries.

(*vi*) *Association of industries* (*Para. 107*).—The Panel considers that an association of industries would be of considerable help in the development of new industries. But cartels are considered definitely undesirable.

(*vii*) *Customs duty* (*Para 108*).—The Customs duty on raw-materials and semi-manufactured goods required for the industry should be remitted for the first 5 years and the duty on finished materials should be increased gradually as soon as manufacture begins to develop. Capital goods required for the industry, should be allowed to be imported free of duty for the first ten years.

(*viii*) *Railway freights* (*Para. 109*).—The present Railway freights on raw materials and finished goods are extremely high and act as deterrant to the development of the fine chemicals and drugs industry. The railway rates should be revised and brought down.

(*ix*) *Excise policy* (*Para. 110*).—A uniform excise policy should be adopted throughout the country and local variations in excise rules should be abolished. The excise duty on spirituous, medicinal and other preparations in all provinces and states should be uniform. Indian made spiritous preparations should have the same facility of movement from one part of the country to another as imported spirituous preparations, when once the duty has been paid at the place of manufacture.

For the manufacture of fine chemicals and drugs where sugar is used as a basic raw material, the present excise duty on sugar should not be levied.

(*x*) *Export* (*Para. 111*).—Scope for export exists and full use should be made to develop the export markets.

(9) *Stages by which the Fine Chemicals and Drugs Industry is to be developed* (*Paras. 112-120*)—(*i*) The Panel considers that the production of two types of drugs should be taken in hand immediately, viz., (1) those which are essential for guarding the health of the public and warding off infectious diseases, (2) those for which India already has or can easily develop raw materials in abundance. Under the first category come the sulpha drugs, anti-malarials (quinine, mepacrine, pamaquine, paludrine) penicillin and streptomycin. The arsenicals and DDT can also be included in this list. In the second group come the drugs of vegetable origin. Products such as quinine, emetin, morphine, caffeine, ephedrine, santonin and essential oils, etc. should be developed to the fullest possible extent, both for the needs of the country and also for export. These drugs are literally to be treated as the wealth of the country to be developed as such. We should also include in this group the biologicals, vaccines and sera, liver extracts, glandular products, etc. Production of insulin on a commercial scale should also be taken up.

There is scope for large expansion of the shark liver oil industry in the country. This work should be taken in hand immediately. In shark liver oil we have a much richer source of vitamin A than cod liver oil. Sharks are in abundance in Indian waters. A central board, representing the relevant departments of the Government of India, the Departments of Fisheries of the different maritime provinces and non-official experts, with a whole time executive should be formed to work out the necessary steps to put the shark liver oil industry on a firm and permanent basis.

(*ii*) The practical way to establish the fine chemicals and drugs industry will be to decide upon the minimum number of drugs and fine chemicals essential for the country. The production of essential drugs should not wait on the production of basic chemicals in the country. We should on the other hand immediately start with the manufacture, utilising the raw materials already available in the country and importing those not available here till we develop our resources.

(*iii*) Among the heavy chemicals, the manufacture of three items, *i.e.*, chloro-sulphonic acid, sodium and chlorides of phosphorus, is very important and should be taken up without delay. The production of intermediates from coal distillation products, such as aniline, acetanilide, chloro-benzene, phenol diethyl aniline, para-anisidine para-nitrotoluene, phthalic acid and anhydride etc., requires immediate attention. Special efforts should be made to produce refined 2° pyridine, which is essential for the manufacture of sulpha drugs.

(*iv*) Among solvents India produces ethyl alcohol in good quantities at competitive prices. Acetone is being produced at one of the Ordnance Factories. This acetone is not required now by the Ordnance Factory for the manufacture of explosives. If the production of acetone in the factory could be kept up the needs of the drug industry will be met to a great extent. Immediate arrangements should be made for the manufacture of other solvents such as acetic acid, butyl and amyl alcohols and also of ethylene oxide which is a valuable intermediate.

(*v*) Steps should also be taken for the manufacture of requisite quantities of lactose, thiourea and guanidine nitrate, the first of which is required for the manufacture of penicillin and the second and third for the manufacture of sulpha drugs.

(*vi*) The Panel feels that the proper development of the fine chemicals and drugs industry leading to self-sufficiency requires a well balanced and integrated plan for the production of heavy chemicals, coal distillation products, organic solvents etc. The production of these starting materials has to be linked up not only with the needs of the drugs and fine chemicals industry but also with those of the dye-stuffs, artificial fibre, plastic, synthetic rubber industries, etc. A programme of production, thus, can be drawn up only by integrating the reports of different panels dealing with the planning and production of the above mentioned raw materials and finished products. The present panel is not in a position to draw up the needed programme in a very concrete way. It recommends that the Government should now set up a technical planning commission to prepare concrete and detailed plans for the development of each of these industries and finding ways and means of implementing these plans.

R. N. CHOPRA, *Chairman.*

S. S. SOKHEY.
J. N. RAY.
K. A. HAMIED. *
B. B. DIKSHIT.
C. J. FIELDER.
HABIB HASAN.
B. C. GUHA.
V. SUBRAHMANYAN.
K. GANAPATHI.
M. B. AMIN.
N. ADHIKARI

} *Members.*

M. K. MAITRA. *Secretary.*

*Signed subject to the note of dissent pp. 42-50.

MINUTE OF DISSENT

BY

DR. K. A. HAMIED.

While the Fine Chemicals, Drugs and Pharmaceuticals Panel has fully emphasised in the Report the necessity and urgency of development of Fine Chemical and Pharmaceuticals Industries in India, it has expressed in several places views with which I cannot agree. In certain places, definitions in the Report are technically wrong.

Several questions arising out of the Terms of Reference, such as (1-A) (2), (3), (4), (5), (8), (12), have not been properly dealt with. In many places the Report does not lay sufficient emphasis uopn its recommendations. The whole Report is more biassed towards the manufacture of drugs rather than chemicals. The manufacture of drugs is subsidiary to the manufacture of heavy and fine chemicals, and hence more emphasis and attetion should be applied to the manufacture of fine chemicals which will lead to the manufacture of all drugs.

As I had gone out of India with the Indian Chemical Manufacturers Delegation to U. K. and U.S.A., I was unable to attend the meetings of the Panel except the last one held on 3rd May 1946, when the final Draft Report was placed before the meeting after discussion. Since the majority of the Members of the Panel did not find it possible to agree with my views, I had to submit this Minute of Dissent.

I. *Erroneous Definitions.*—The distinction between Fine Chemicals, Drugs and Pharmaceuticals as stressed in paragraphs 4 and 5 of the Report is not technically correct. It is stated that chemicals which are produced and consumed in very large quantities are usually described as heavy Chemicals, whereas those which are manufactured in comparatively small quantities are described as Fine Chemicals. This distinction between Fine and Heavy Chemicals is erroneous. The fact is that scientifically there is no distinction between the two. Certain chemicals, such as Sulphuric Acid, Hydrochloric Acid, Nitric Acid, Caustic Soda, Soda Ash, Chlorine, etc., have been by usage in popular language, termed Heavy Chemicals. Perhaps this was due to the fact that in former times these were the only chemicals requiring heavy plant and machinery. The rest of the chemicals not included or allied to these were known as Fine Chemicals. At present this distinction also does not exist, but the terms " Heavy " and " Fine Chemicals ", continue to be vaguely used.

In para. 5 it is stated, " A large proportion of Fine Chemicals is used as Drugs ". The word " Drug " is not defined at all. Pharmaceuticals are described as " Preparations of Drugs made up for use". The entire paragraph is misleading. In the language of Chemistry the word " Drug " does not appear at all. It is a layman's word used to describe ready -made medical products. Correctly speaking the word " Pharmaceutical " which is now used in scientific language, is identical to the word " Drug ". In Germany and other Continental countries, the word " Drug " (Drogen), is only used for medicines derived from herbs and plants. In my opinion, the word " Drug " should be completely removed from the Report and the Government be requested to rename the panel as " The Panel on Fine Chemicals and Pharmaceuticals. "

II. *Distillation Products of Coal.*—In paragraph 15, page 8 the last two sentences read :—" Benzene and Toluene are produced in Coke Oven Gas Recovery Units at the Steel Works. These plants are Government owned and it is desirable that the Government of India should continue them in operation, utilising the products as motor fuel until such time as the Fine Chemical Industry is ready to absorb them ". I do not know whether the Coke Oven Gas Recovery Units belonging to the Steel Works producing Benzene and Toluene are Government owned. The Government have their own Coke Oven Gas Recovery Units apart from these owned by the steel works. I do not agree that the Government should continue to own and operate these plants and utilise the products as motor fuel. The Government should hand over these plants immediately to proper chemical industrial concerns for utilising Benzene, Toluene and other products for the manufacture of various essential organic chemicals.

III. *Objects to be Achieved & Targets for production.*—The objects to be achieved, as mentioned inpara. 7, are based more on sentiment than on facts. No country is, or can be, self-sufficient in regard to Fine Chemicals and Pharmaceuticals. One is dependent on another. In many cases it will be impossible to make Fine Chemicals for which facilities and raw materials are not available in this country. In other cases, it may happen that certain chemicals can be produced but not cheaply enough. The aims and objects, therefore, should be to see that all Fine Chemicals and Pharmaceuticals which *can* be produced from raw materials available in this country are manufactured in sufficient quantities for the requirements of the country within the next 15 years. It should not be the aim to try to manufacture what other countries are manufacturing but to manufacture what India can manufacture from raw materials available in India.

The targets for production, as given on pages 17, 18 and 19, for pharmaceuticals and fine chemicals are, in my opinion, arbitrarily fixed. The list is not fully representative of the vast range of fine chemicals. Undue preponderance and emphasis has been given to pharmaceuticals. Fine Chemical Industry both organic and inorganic, should be the main subject of recommendation as manufacture of pharmaceuticals, specially of the synthetic ones is subsidiary to the manufacute of fine chemicals. Further, the Report recommends the production of each individual chemical and pharmaceutical mentioned in the Report. It is not possible to deal with the manufacture of chemicals and pharmaceuticals individually. It is well known that in chemical and pharmaceutical manufacture, one product leads to the manufacture of another. It is in fact by this process that the Chemical and Pharmaceutical Industry has gradually developed throughout the world. The same process of development will have to be followed in India.

IV. *Difficulties Hampering the Development of Fine Chemical & Pharmaceutical Industry.*—Before going into the question of planning the development of Fine Chemical and Pharmaceutical Industry, it is necessary to analyse the causes which have been responsible for the non-development of such industries in India. Without this analysis no plans for the future can be properly made. If the causes and factors hampering this development in the past are

once known and eliminated, the industry will automatically expand and develop. The Report has very briefly touched this problem (paras. 41 to 48), and its recommendations also are not very emphatic.

In my opinion, the undermentioned difficulties are completely blockading the establishment of new and the development of existing Fine Chemical and Pharmaceutical Industry in this country.

(1) *Cost of Transport.*—For any industry to be established and run economically, the cost of transport of basic materials and finished products must be as low as possible. In India, although the railways are State-owned, the cost of transport is excessive. As an example, I would add that the freight on chemicals in U.K. is about Sh. 50/- to Sh. 90/- per ton for a distance of 500 miles, whereas in India the freight is Rs. 4/6/- per maund, which works out @ Sh. 180/- per ton. This is more than double the freight in U.K. The result of such heavy cost of transport is, that basic chemicals already available in India, such as Benzene, Toluene, Naphthalene and subsidiary chemicals such as Acids, Alkalis, Chlorine, etc., are not being utilized for the manufacture of fine chemicals, both organic and inorganic. A number of dyes can also be made immediately in India from these same raw materials, but the cost of transport alone makes it prohibitive for any chemical industrialist to undertake to establish such industries. The existing chemical and pharmaceutical concerns cannot expand their activities also due to the same cause.

With the question of transport is connected the question of containers necessary for the movement of basic chemicals. There are no facilities provided by the railways in India of Tank Wagons for the transport of corrosive, non-corrosive and inflammable chemicals. The existing practice of packing in jars, drums, etc., is too costly and therefore uneconomic. In U.K. and U.S.A. the railways provide Tank Wagons for the transport of all types of basic organic chemicals, such as Benzene, Toluene, Phenol and also for Liquid Chlorine and Acids, the latter being made of non-corrosive material. How this is hampering the development of industry can be visualised from the fact that Sulphuric Acid, one of the very important basic subsidiary chemicals, cannot be transported from one place to another due to high cost of transport and non-availability of Tank Wagons. With the result that in certain places in India Sulphuric Acid is in abundance while in others there is a shortage. In America and U. K. transport facilities for all types of chemicals, both organic and inorganic, are so great that chemical industries have been started at hundreds of places. In India, important basic organic chemicals, such as Benzene, Toluene and Naphthalene are produced in moderate quantities for production of a large number of intermediates, fine chemicals and pharmaceuticals. It is unfortunate that these important basic materials, although available, are not utilised for this purpose. Benzene is being used as motor fuel and Toluene and other basic materials are lying unused.

India produces a number of medicinal plants rich in Alkaloids and Glucosides and Essential Oils. These plants generally grow in hilly regions, such as Kashmir, Himalayas, Baluchistan and in the South. The active principles contained in these medicinal plants are generally in the neighbourhood of 1%

to 2%. The cost of transport, therefore, plays a very important role if these raw materials are brought from the places of their growth to the places where extraction and manufacture of the active substances takes place. If India is to develop her alkaloid Industry, the cost of transport must be reduced to the very minimum. In short, from what I have said above, it will be clear that this one factor alone, namely the high cost of transport and the non-availability of tank wagons, has been responsible for the non development of fine chemical industries in India. If it is desired that this industry should expand and grow without any further delay, the best plan would be to bring the freights for raw materials and finished products to the lowest possible level.

(2) *Import Duties.*—This is another factor which unnecessarily raises the initial capital for starting of industries. No tariff duties should be imposed on the import of machinery when such machinery is not manufactured in the country and is urgently required for the development of vital industries. Chemical Industries depend to a great extent on experimentation and research. They have to maintain Industrial Research Laboratories and are faced with the difficulty of paying enormous sums in the form of Customs Duty to the Government on scientific research apparatus so vital for the development of Chemical Industries of the country.

Technical personnel, good or bad is today being recruited by the Industry from the existing Universities and Technical Schools in India. The training of these technical men remains of a low standard as the universities and technical schools from their meagre finances, cannot afford to purchase sufficient laboratory apparatus needed for research and teaching on account of the fact that the cost of equipment increases by 30% due to Customs Duties. It is therefore, imperative that Customs Duties must immediately be abolished on all types of chemical laboratory apparatus for teaching and industrial research.

The manufacture of a number of essential pharmaceuticals, specially synthetic chemo-therapeutic substances, depends on the availability of fine chemicals. So long as these chemicals are not manufactured in India, it is desirable that Import Duties on basic fine chemicals required for the production of essential pharmaceuticals should be waived.

(3) *Import Trade Control.*—Another difficulty which is facing the manufacturers today and stands in the way of rapid development of Chemical industries, is the Import Trade Control. It was believed that these import controls will be terminated soon after the war, at least for the sterling areas. But it appears that there is no sign of decontrolling the import of machinery from non-Sterling or Sterling areas. Even small machines required for the Pharmaceutical Industry which are available in England and the manufacturers there ready to supply, cannot be purchased before several months are wasted in obtaining a permit for import of such machinery from England. In a country like India, where manufacture of plant and machinery for the Chemical Industry is practically non-existent, all types of restrictions on the import of machinery should be immediately removed.

(4) *Excise Rules.*—Alcohol is an essential constituent of a number of pharmaceuticals. In many others it is used during the manipulations of

manufacture. Several fine chemicals also require alcohol for crystallisation and purification. The present Excise Laws were framed as late as 1878. At that time no Fine Chemical and Pharmaceutical Industry existed in the country. A change in these laws is essential. These laws do not contain any provisions for the use of alcohol in pharmaceutical and fine chemical industry. In U. K. Industrial Alcohol is provided by the Excise. This alcohol is good enough for all chemical processes but not for potable use. Hence the use of this Industrial Alcohol by chemical and pharmaceutical manufacturers does away with the various restrictions of Excise Laws. No such industrial alcohol is available in India. The system of filling up a number of forms and maintaining a number of voluminous registers causes great inconvenience and delay. The Industry, therefore, besides other difficulties is suffering from the existing Excise Laws.

Further, the Excise Laws vary from Province to Province restricting the free movement of Spirituous Pharmaceutical Products which increases the difficulties of the trade and hamper the development of the Pharmaceutical Industry. Representations made to the Government by Chemical and Pharmaceutical Associations and individual firms have been in vain. Foreign made pharmaceutical products as well as toilet preparations containing alcohol have no such difficulties to encounter as once the duty is paid at the port of entry, there is no provincial excise barrier to restrict their free movement. The Excise Rules must, therefore be immediately revised and brought in conformity with similar rules in U. K. and other countries.

In my opinion, therefore, the first and foremost essential step towards planning for the development of chemical and pharmaceutical industry should be the removal of the main existing difficulties stated above. Further facilities and help as may be required by the industry should be given promptly. This alone more than anything else, would result in an immediate expansion of the existing industries and lead to the opening of new chemical concerns who will be in a postion to undertake of their own accord the manufacture of hundreds of items belonging to this industry.

V. *Lack of Control over Standards.*—The Panel was required to go into the question of Controls if any which should be exercised by Government if the industry is to be under private ownership and managment. (Terms of Reference No. 8). The Report has not dealt with this question at all. Under the caption " Difficulties Hampering the development of Fine Chemical and Pharmaceutical Industry " (paragraph 41) the Report has dealt with the lack of Control over Standards as one of the causes hampering the development of Chemical and Pharmaceutical Industry. Paragraph 46 of the Report deals with the lack of Control over Standards. Again it is evident that the authors of the Report have in mind only the control over drugs and pharmaceuticals. I do not agree with the remarks in paragraph 46 of the Report : " Spurious drugs and alkaloids and biological products below their strengths are now being sold with impunity. " This is a very sweeping statement and should not have formed part of the Report. Many important Alkaloids, such as of the Opium Group, are made and sold only by the Government at their Ghazipur Factory and hence should not be spurious. Biologicals are made by a few important

private concerns in Calcutta, the Haffkine Institute at Bombay and few other Government Institutions and it is claimed by them that their products are not below the Standards.

While fully agreeing with the necessity of the Drug Act to come into operation as soon as possible, I, however, feel that it is not only desirable but very necessary for the Government of India and Provincial Governments to take immediate steps to establish Chemical and Drug Testing Laboratories. Analytical Control and testing of chemicals and pharmaceuticals is not an easy work. Besides first class special equipment, the work requires highly trained and qualified personnel. It is beyond the capacity of an ordinary B.Sc., M.Sc., or even a D. Sc., to analyse drugs and chemicals, unless he has a full training in such work. The establishment of Laboratories, therefore, must go hand in hand with the training of expert personnel. Steps, therefore, should first be taken to determine the number of personnel, their qualification and training required for working in all the Testing Laboratories in India. Arrangements should be made to have the personnel trained and at the same time the Laboratories established before bringing the Drug Act in operation. To introduce the Drug Act and bring it in operation without the establishment of such Laboratories will, in my opinion, be injurious to the trade and liable to lead to mal-practices.

The same remarks, more or less, apply to the introduction of Pharmacy Act. The Pharmacy Act is very essential but before it is introduced, full arrangements must be made for the training of compounders in suitable schools which must be immediately established for this purpose.

VI. *Patent and Proprietory Medicines.*—The Report has devoted a full and lengthy paragraph (49), to this subject. It is irrelevant to the Report and the Terms of Reference for which the Panel was constituted.

The manufacture of and trading in patent and proprietory medicines had become a world industry and ranks probably among the third of the major industries of the world. In countries like U. S. A., U. K., and other continental countries, the practice of prescribing patent and proprietory medicines has completely overshadowed the old practice of writing long prescriptions which is still prevalent in this country. It is the result of our present-day civilisation which has brought speed and activity in every sphere of life. A prescription as written by a doctor takes hours and hours to dispense—sometimes one has to wait for a whole day. This in fact is the cause for the continuous increase in the demand of patent and proprietory medicines which are sold ready-made at the counter requiring no waste of time.

In a country like India, two crores worth of patent and proprietory medicines, as gauged in the present Report, is not a big figure at all. In U. S. A. with a quarter of the population of India, the sale of patent and proprietory medicines is several times greater. Same is the case in U. K. and other countries of Europe. Expressions such as " Barring a few exceptions these preparations are entirely worthless. Some of them actually contain ingredients that are positively injurious.....they cause incalculable injury by leading sick person to delay in securing proper medical treatment " are

positively wrong, misleading and calculated to cast a slur not only on the Indian patent and proprietory medicines but on those of the entire world. Further statements made in that paragraph mention," The trade in *secret drugs* is thriving on the ignorance and credulity of the people." I cannot understand what the authors of the Report had in mind by the words Secret Drugs " If they mean Ayurvedic and Unani medicines, then they have no right to class them as such because they are ignorant of the Unani and Ayurvedic medicines and cannot pronounce opinion on a completely different system of therapy with which they are not familiar and which has been in practice in India since time immemorial, If by " Secret Drugs " they mean Patent and Proprietory Medicines of the Western System, then again the authors of the Report are wrong to term them as " Secret ", because no manufacturer in India or abroad, worth the name is producing " Secret Drugs " for which the authors have estimated the value of 2 Crores in India and much bigger in America and U. K. Formulae and composition of almost every patent and proprietory medicine is mentioned on each and every package. What is more surprising is the fact that under the Targets of Production, the authors of the Report have themselves mentioned the names of a number of patent and proprietory medicines which they wish to be made in India.

Personal sentiments and prejudices should not have been brought into the Report.

VII. *Private or State Ownership of Industry.*—The Terms of Reference No. 2 reads : " Whether the industry should be under Government ownership either on grounds of National interest or because private capital is unlikely to take it up and if so, whether it should be wholly or partly managed by Government. " This question of State Ownership as against Private has not been properly dealt with in the Report. In fact it was not possible for a Panel like ours to give a decisive opinion on this question which is facing the world today. I, therefore, feel it necessary to express my views on this very important question.

Apart from Soviet Russia where under a rule of dictatorship, industries are State-owned and State-controlled, in no other country of the world industries are under State Ownership. Private Ownership has the great advantage of free competition between industry and industry whereby each manufacturer is forced to develop new methods of manufacture. This leads to continuous scientific industrial research and advancement. The development of science and industry as it is today in the world, has been achieved through private enterprise during the last fifty years.

Under a democratic system of Government where people are free to live and act as they like, it is not possible to introduce the system of State-ownership of industries. The technical man under a democratic system, whether in the upper or lower grade, is free to work or not. He can therefore, refuse to work in State-controlled industries and the State will have no means of compelling a technical expert or a labourer to work. It is only under a dictatorship rule that labour, both manual and technical, can be compelled to work, as is the case in Soviet Russia, or was in Nazi Germany and Fascist Italy. In a free civilized country, run under a democratic system of Government, such ownership and control is, therefore, not possible.

It has been observed that whenever an industry is taken over by the State, it becomes stagnant for want of competition. This is no where more true than in India. State Officials in-charge of industries are irremovable from their posts and do not act with the same spirit as managers and supervisors work in private-owned industries. To give a few examples : Compared to the private owned systems in U. K. and U. S. A., the Railway System in India, which is State-owned, is functioning much worse not only in respect to railway fares, freights, but in respect of comfort and travelling, conditions of carriages and bad management, both as regards accomodation and timings of trains. The Telephone Company in Bombay, since it has been taken over by the Government, has been functioning worse than ever. Certain factories, such as for the production of Opium Alkaloids at Ghazipur, the Quinine Factories in Madras and Bengal, are not working as business concerns producing such products should work. In view of these conditions prevailing in the existing State-owned industries, one is doubtful whether more industries, specially those requiring expert technical knowledge and management like the Chemical and Pharmaceutical Industry, should be State-owned and Managed.

Further it is admitted by the Provincial Governments as well as by the Central Government that there is corruption in number of Government Departments. It has been found necessary by the Provincial Governments to appoint special Anti-Corruption Boards to remove all types of mal-practices. Under such circumstances, there does not seem to be any necessity for the Government to take the burden of opening new departments by undertaking the ownership, management and control of complicated industries.

The Report has not properly dealt with Item (3) of the Terms of Reference. Private Capital has always been forthcoming whenever an industry could be established on reasonable economic basis. The causes which have been responsible for non-expansion of chemical and pharmaceutical industry on a much larger scale than at present have been analysed by me in paragraph IV of this Minute. The scarcity of Capital has never been the cause. At present Capital is much more available for establishing new chemical industries provided, however, the hindrances which stand in the way of development and economic running are removed.

If, however, in spite of the removal of all these causes, the Capital is not yet forthcoming, the Government, taking into consideration the importance of any particular requirement of the industry, may invest part of the capital in order to attract larger public capital. In such cases Government naturally will have the right of participation in the management of the concern in proportion to the capital invested by the Government. This system is being practised today by the Indian States where we find that the industries are more rapidly growing than in British India. The Indian States are further helping the establishment of Industries by affording various facilities, such as free land, remission of income-tax for a period of 5 to 10 years and patronising the products manufactured in the States.

In the case of such industries as may be vital in the interest of the Nation and yet no private capital be forthcoming for any reasons, the State has certainly the right of starting such industries.

VIII. *Location of Industries (Terms of Reference No. 6).*—I do not agree with the Report (paragraph 106), that " Industries should be located primarily on the consideration of availability of raw materials labour, consumption and distribution facilities. " The location of industries* is mainly a matter of convenience to the promoter of the industry. Consideration of availability of raw materials at the spot is not a very big factor. Some of the best products are manufactured at places in various centres of the world from raw materials brought from far off places to the place of manufacture. Trained labour is a factor to be taken into consideration but this also is not the decisive factor. Consumption of the articles manufactured and facilities for their distribution take a secondary position in relation to other facilities which the promoter may find convenient for himself.

The location of industry, therefore, should mainly be the consideration of the promoter of the industry who, when investing large capital, is surely capable and careful enough to ascertain the best locality where he should establish that industry.

The Terms of Reference No. 8 has been wrongly construed in the Report. Under control, the Report seems to have taken the view Drug Control and as such emphasised the necessity of bringing into operation the Drug and Pharmacy Acts (paragraphs 46 and 47). Regarding the Drug Act and the Pharmacy Act, I have expressed my views in paragraph V above.

Regarding the controls which Government desires to know should be exercised if industry is to be under private ownership, are quite different from the controls under the Drug Act and Pharmacy Act. If industry is to be private-owned, as I have emphasised it should be, for reasons given in pharagraph VII of this Note, the controls fall under three categories :

(1) The control of Standards and Quality.

(2) The Control of Capital Issue, Location.

(3) Labour Welfare.

The first is covered by the Drug and Pharmacy Acts. The third is covered by the Labour Dispute and Industrial Act and the second requires no control, if industry is to flourish and expand on a wide scale.

IX. *Cottage Industry.*—Item No. 12 of the Terms of Reference, namely " Should the Industry be developed as in Japan on the Cottage Industry basis, and if so, to what extent ", has not been dealt with in the Report at all. Fine Chemical and Pharmaceutical Industry cannot ever be made a cottage industry like other industries, such as glass, match-making, textile, etc. Chemical Industry is a highly technical one and has no chance of developing on the basis of cottage industry. So far as I know this industry was never a cottage industry in Japan as the Terms of Reference suggests.

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* The industries referred to here are only fine chemicals and pharmaceuticals.

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APPENDIX I(a)

NOTES ON THE GALENICALS AND TARGET PRODUCTION OF ALKALOIDS

BY MR. M. B. AMIN.

As agreed in the first meeting of the Panel on Fine Chemicals, Drugs, and Pharmaceuticals, I take pleasure in submitting here below my notes for the production of Galenicals and the proposed Target of production of the Alkaloids-Caffeine, Ephedrine, Emetine Morphine, Quinine and Strychnine.

Note on Galenicals.

By Galenicals it is generally meant the drugs of the vegetable kingdom usually extracted and preserved by the Alcoholic media. Thus the Extracts and Tinctures make a section of medicines commonly called Galenicals. Requisites of the Galenical Industry. The Chief requisites are (1) Vegetable Crude Drugs, (2) Alcohol, (3) Equipment and (4) Personnel.

(1) *Crude Drugs.*—In India with variable soil and climatic conditions most of the vegetable drugs as are commonly used in medicine grow freely. For several drugs that are not indigenous to this country, it is possible to find in some instances suitable indigenous substitutes, and in many cases it has been found possible to grow and acclimatise those drugs in this country. Thus so far as the basic need of the raw drugs is concerned, India can well afford to be self-sufficient in most of these important vegetable drugs.

(2) *Alcohol.*—It is needless for me to say that plenty of alcohol of indigenous manufacture is available in this country and this requirement can be met to the fullest without the least difficulty.

(3) *Equipment.*—As regards the equipment it is so simple that all what is needed for the industry can be fabricated locally by the engineering firms and copper and black smiths. The commonly needed equipment consists of percolators, jars, drug-mills and crushers, filter presses, filter stands, steam pans, vacuum stills, Drug stills, etc. In most cases tin-coated copper equipment serves the purpose but in some cases it may be necessary to have porcelain or enamel ware which it may be necessary to import.

(4) *Personnel.*—There are a number of Pharmaceutical Houses in this country with well established Galenical industry. There is enough trained and experienced personnel and there is no difficulty in this direction.

General remarks to achieve Target production.—The Panel has not yet fixed any Target figures for galenicals. It may, however, be said that the galenical industry is one of the long pre-war established industry in this country and in order to achieve any larger production for achieving the Target to meet any larger needs it is only a question of expansion of the existing industry and for such needed expansion the industry will be able to take care without any technical difficulty to meet the growing demands and achieve the target productions.

General Remarks.—Although the galenical industry is thus well established for long there are several handicaps for the smooth and economic existence and expansion of this industry and I would like to draw the particular attention to some of them.

(1) Galenical products consist mostly of extracts, Tinctures and as I have stated above they are alcoholic or spirituous products. Thus as these medicines contain alcohol these galenical drugs manufactured in this country have become victims of indiscriminate territorial excise restrictions, both as regards excise duties and their interterritorial movement from one province or State to another ; these restrictions are placed only on the products manufactured in India and not on those imported from overseas. The explanation as given by the Indian Govt. it is understood, is that the imported drugs form the subject of the Central Government and so the imported goods on which once the excise duty is paid at the port of entry can move freely in any part of India without any let or hindrance by the provincial or State Governments, but in case of the same drugs manufactured in India it becomes the provincial subject and so each province formulates and

exercises its own individual excise restrictions and regulations according to its fancy as regards duties and movement of those drugs from one province or State to another. Whatever may be the reasons, this discrimination between the imported and locally manufactured spirituous goods is neither logical nor sound and has stimulated imports at the cost of the Indian industry. So if Indian galenical industry is to thrive and expand the excise restrictions and regulations on the spirituous products manufactured in this country must also form the Central subject for unification of excise duties and free movement of the goods in any part of this country.

(2) Although most of the vegetable drugs as raw materials needed for the industry may likely be available within the country, there are some vegetable drugs which yet need to be imported as raw materials for the galenical industry I suggest that import of such crude drugs that do not grow at present in this country or are not available in sufficient quantities should be allowed to the Pharmaceutical industry for manufacturing purposes without tariff duties until they become satisfactorily available within the country. I further suggest that a list of such crude drugs that are needed to be imported for such manufacturing purposes be prepared for recommendation of exemption from import duties.

(3) In order to ensure reliable supply of indigenous crude drugs to the manufacturers it is desirable that (*a*) the Government should make and publish a comprehensive survey of the medicinally useful indigenous drugs giving names of the places where they grow ; the total quantities of each drug available at present ; the optimum conditions for their cultivation and growth ; the proper seasons of collection of the drugs and methods of their drying and storage for obtaining and preserving the maximum therapeutic value. The Government should also incorporate in this book the details of identification of those drugs and also set the purity standards and tests. Of course much of the information suggested above is available in scattered literature on drugs sporadically published by the Government as well as various eminent scientific workers as Sir R. N. Chopra ; however it is desirable to have an up-to-date revised authentic book giving all this information in an authoritative publication under the auspices of the Government and have it periodically revised to keep it up-to-date. (*b*) The Government should institute a bureau and a laboratory whose function should be to advise and help as to the cultivation, collection and distribution of drugs and also help whenever so desired in the identification and testing such crude drugs to their genuineness and medicinal stability. Also this bureau should maintain a museum of all authentic useful drugs for the above purpose.

(3) Ample transport facilities at specially low rates should be provided for transport of crude drugs.

(4) In the British Pharmacopoiea there are about 54 official galenical preparations from about 35 drugs all of which are being manufactured in India. Majority of the crude drugs need are available in India but there are a few important drugs that do not grow here and so in order to make this country self-sufficient in her needs of the important crude drugs the Government should carry on experiments to grow those important drugs that are imported and when successful immediate efforts should be made to cultivate those drugs on large scales to meet the entire needs of this country. Incidentally I may refer that two of the important drugs namely Ergot and Ipecacuanha, I understand have met experimental success for cultivation in this country and it is desirable that these successful experiments should be quickly commercially expanded to meet the whole need of the country. Similarly the Cinchona plantation should be rapidly expanded to meet the country's need for galenical preparations as well as for the manufacture of quinine to cover the entire need of the country to the fullest.

Notes on the Target Production of the Alkaloids.

The general methods of manufacturing alkaloids from the crude drugs are too well-known to be detailed here. The following are in brief the fundamental needs for the manufacture of Alkaloids from vegetable drugs.

Requisites for the manufacture of alkaloids.— (1) Crude drugs containing the alkaloids, (2) Organic solvents such as alcohol, Chloroform, Ether, Acetone, Benzene, Petroleum Ether etc., (3) Alkalis such as Caustic Soda, Lime, Sodium Carbonate, and Ammonia Acids chiefly Sulphuric and Hydro-chloric, (4) Equipment, (5) Personnel.

(1) *Crude Drugs.*—Resources for the manufacture of the alkaloids namely Caffeine Ephedrine, Emetine, Morphine, Quinine and Strychnine are Tea Waste Ephedra herb ipecacuanha roots, opium, cinchona bark and nuxvomica seeds respectively. All these six drugs grow in this country and in order to achieve the target production of the alkaloids what is necessary is to plan sufficient crops of these drugs so as to meet the needs for these drugs as specified later on under individual consideration of each alkaloid.

(2) and (3) *Solvents, Alkalis and Acids.*—All of them are produced in enough quantities in India and their production can be increased if need be and so there should be no difficulty for provisions of these requisites.

(4) *Equipment.*—Much of the equipment required is not complicated and it may be constructed locally. It may, however, be necessary to import some of the equipment such as enamelled or glass-lined ware, centrifugal machines, vacuum and solvent recovery stills etc.

(5) *Personnel.*—I feel there would be no difficulty to procure enough suitable workers from the country.

Quantities of Crude Drugs necessary for the Target Production of the Alkaloids.

Planning for the adequate local availability and efficient supply at competitive prices the necessary quantities of the crude drugs is most important. Here below, therefore, are detailed four estimated quantities of Crude Drugs necessary for the proposed Target Production of each Alkaloid.

Caffeine.—(Target production 30,000 lbs. per annum) Caffeine may be prepared from Tea Waste available in very large quantities in this country and in which it exists from 1 to 4 percent. Taking an average yield of about 2 percent, the quantity of Tea Waste annually required for the production of 30,000 lbs. Caffeine is 15,00,000 lbs.

Ephedrine.—(Target production 5,000 lbs. per annum)—Ephedrine may be prepared from the species of Ephedra herb indigenous to this country. The content of ephedrine in the crude drug varies from 0·5 to 1% of ephedrine. Taking an approximate average yield to be 0·75% of ephedrine, the annual requirement of the ephedra drug for the production of 5,000 lbs. ephedrine is about 6,66,800 lbs.

Emetine.—(Target production 200 lbs. per annum)—Emetine may be obtained from the Ipecacuanha roots in which it occurs from 1·25 to 2 percent. Taking an approximate yield at 1·25 percent the total quantity of the Ipecacuanha roots annually required for the production of 200 lbs. emetine is 16,000 lbs.

Morphine.—(Target production 3,000 lbs. per annum)—Morphine can be manufactured from Opium. Indian medical opium contains about 7 to 12% morphine. Taking an approximate yield of 10 percent Morphine from opium the quantity of opium annually required for the production is 30,000 lbs.

In this connection I may point out that the manufacture of morphine has been monopolised by the Indian Government to themselves only, which is contrary to the usual practice adopted in more advanced countries of the west. In Great Britain and in U.S.A. the manufacture of opium alkaloids has been allowed to private industries and it is desirable that a similar practice be adopted in this country also with similar necessary Government supervision and restrictions to prevent illicit use. This matter has been several times placed before the Indian Government individually as well as through trade associations, Commerce Chambers, Federation of Commerce and Industries, Baroda Government and various other bodies, but all these public appeals have so far failed to move the Government attitude otherwise. The Government monopoly in this respect continues to perpetuate a feeling of inferiority complex and unfavourably tells upon the ethical integrity of the chemical manufacture of this country in the international eyes. I therefore would like that the panel should study the whole case as has been so far put before the Government at various occasions and offer its criticisms in the matter as to the advisability or otherwise of permitting the manufacture of Opium alkaloids to private agencies in India in manners similar to those prevailing in Great Britain or U.S. America.

Quinine.—(Target production 20,00,000 lbs. per annum.)—Quinine is the alkaloid obtained from Cinchona bark. The percentage of Quinine in various species of Cinchona varies very much and may range from 1·5 to 4% or higher. Taking an approximate yield of 2·5 percent of quinine, the annual requirement of the cinchona bark for the production of 20,00,000 lbs. of Quinine per annum is 80,000,000 lbs.

Strychnine.—(Target production 3,000 lbs. per annum).—Strychnine may be obtained from Nuxvomica seeds. It occurs in nuxvomica seeds to the extent of about 0·8 to 2·5 percent. Based on an approximate yield of 1·5% strychnine, the quantity of Nuxvomica seeds annually required for the yearly production of 3,000 lbs Strychnine is 2,00,000 lbs.

Location of alkaloid industry : General observations.

(1) *Location of the manufacture of alkaloids.*—So far as the manufacture of Alkaloid is concerned, it is only a small section of the fine chemical industry. The manufacture of alkaloids chiefly concerns the galenical and pharmaceutical industries. Except for the production of Morphine and Quinine (the former being legally forbidden to be manufactured by private industries in this country and the latter being not possible on account of the unavailability of the Cinchona bark at competitive rates and the government being interested in its manufacture) all the remaining four alkaloids are manufactured at present on smaller scales in the existing galenical and pharmaceutical industries of this country, the question of larger production of alkaloids to achieve the target means expansion of the existing production. In the manufacture of alkaloids, besides the crude drugs, large quantities, of other processing requisites such as alcohol, benzene, ether, Chloroform and other solvents alkalis and acids etc., are also required and consideration of their transport to the place of manufacture is very important. The small advantage of saving in transport of the crude drugs which can be achieved by manufacturing alkaloids at places where crude drugs grow will be far outweighed by many such disadvantages. Further, the technical supersvision, establishment and running charges, equipment, trading and distribution facilities will be more favourable in the large pharmaceutical and galenical industries than what can be economically expected in different independent separate alkaloid manufacturing schemes as these are only very small partial activities of the larger galenical and pharmaceutical industries and as such can be handled with greater economy in producing and overhead charges and greater conveniences. Therefore, if considered from all visions, it is not necessary to carry out manufacture of the alkaloids at the places where crude drugs grow ; in fact, the location of manufacture of Alkaloids is immaterial if it is carried out by competent large galenical and pharmaceutical industries.

(2) I understand Russia and many advanced countries provide facilities for special cheap transport of crude drugs for manufacturing purposes ; it is desirable that in order to stimulate growth of the fine chemical and pharmaceutical industries in this country threatened with keen foreign competition, the Indian Government should provide for very cheap transport of the crude drugs, essential technical heavy chemicals, solvents and several such articles required for manufacturing and processing purposes by the pharmaceutical and fine chemical industries. The Government also should extend protection to these industries by proper Tariff formulation to prevent undesirable dumping of foreign goods affecting adversely local production. Also exemption from Government duties and taxes should be granted to those raw and technical materials which are liable to such taxes when they are required for manufacturing and processing purposes by industries.

APPENDIX I (*b*).

Supplementary Report on Galenicals, Alkaloids, Etc.

(*By Mr. N. Adhikari*).

Galenicals.—

The all India consumption of spirit for the manufacture of Galenicals is about 4,00,000 L.P. gallons per annum besides that consumed by the Government factories at Bombay and Madras and the total value of the different kinds of equipment in use for this purpose amounts approximately to Rs. 3,00,000.

Taking the target production of Galenicals at the end of 15 years to be five times as much as the present all India figure (besides the quantities manufactured in the Government factories) nearly 20,00,000 L.P. gallons of spirit will be necessary annually and proportionately about Rs. 15,00.000 will be required for capital goods of which 10% is to be imported.

As regards the list of equipments please refer Mr. Amin's report.

Alkaloids.—

To produce the different kinds of alkaloids mentioned in Mr. Amin's report to the extent decided upon namely—Caffeine-30,000 lbs. per annum ; Ephedrine—5,000, lbs. per annum ; Emetine—2,000 lbs. per annum ; Morphine—3,000 lbs. per annum ; Quinine—20,00,000 lbs. per annum and Strychnine—8,000 lbs. per annum—45,000 gallons of Commercial Benzene, 10,000 gallons of Naphtha, and about 4,000 gallons of petrol with equal quantities of Chloroform and Ether will be required per annum. The quantity of Batching oil required for quinine extraction could not be given but since the loss of solvent in the manufacture of this alkaloid is practically nil annual replenishment therefore need not be considered. Principal solvent for Morphine is water and the small quantities of others will be available from provisions already made.

Capital expenditure for the manufacture of the alkaloids mentioned in the report except Quinine will amount to Rs. 6,00,000. This figure does not include the cost of buildings, manufacturing sheds, storing vessels and jars.

APPENDIX II.

A NOTE ON THE MANUFACTURE OF SULPHA DRUGS IN INDIA.

(Dr. K. Ganapathi, D.Sc. and Lt. Col. S. S. Sokhey, I.M.S.)

1. *Importance of the Sulphonamides.*—The sulphonamides now occupy a pre eminent position in the treatment of numerous bacterial infections against which very little could be done previously. In fact, sulphonamides with penicillin and atebrine can take care of more than three-fourths of all the major illness that afflict India.

To the question whether the advent of penicillin will displace the sulpha drugs, the answer is definite. From the therapeutic point of view, pencillin is an effective supplement but not a substitute for the sulphonamides. The modes of action of these two classes of drugs are dissimilar and their spectre of therapeutic activity are not exactly the same though they overlap in certain regions. Actually, in the antibiotics we are primarily looking to cover the regions wherein sulpha drugs are of no use. Further the sulpha drugs, unlike penicillin and other biological products are very stable and can be stored almost indefinitely. Because of this property, sulpha drugs will be the drugs of choice for use in the rural areas of India. The use of penicillin will be limited for long to urban areas.

The sulpha drugs have revolutionised the treatment of bacterial diseases and can be used in the treatment of some of the deadly epidemics which decimate India. Therefore, these drugs must be produced on a large scale and made available at the lowest possible cost to permit of their being used for mass treatment. Because these drugs will be used largely by the poorer sections of the community, their cost becomes a vital factor For these reasons, their production by the State becomes essential to eliminate the private profit element which usually makes up the largest part of the selling price of drugs. As shall be shown below, from the combination of a set of fortunate circumstances the State is in a particularly favourable position to take up their manufacture.

2. *Sulpha drugs that require to be manufactured in India.*—In a race to discover better and better drugs, nearly 3,000 sulphonamides have been synthesised and studied. Of these, only the following drugs have been selected for and given clinical trials:—

Prontosil
Prontosil Soluble
Proseptasine
Soluseptasine
Sulphanilamide
Albucid (N^1—acetyl sulphanilamide)
Irgamide (N^1—dimethylacroyl sulphanilamide)
Irgafen (N^1 —3 : 4 dimethylbenzoyl sulphanilamide)
Uleron
Sulphapyridine
Sulphathiazole
Sulphathiadizole
Sulphadiazine (2-Sulphanilamido pyrimidine)
Sulphamerazine (2-Sulphanilamide-4-methylpyrimidine)
Sulphamethazine (2-Sulphanilamide-4 : 6 dimethyl-pyrimidine)
Sulphapyrazine (2-Sulphanilamidopyrazine)
Sulphaguanidine
Sulphasuxadine (N^4-succinglsulphatiasole)
Sulphaphthalidine (N^4-phthaloylsulphathiazole)
Promin (A derivative of 4 : 4′-diaminodiphenylsulphone)
Diasone (Diformaledehyde sulfoxylatederivative of 4 : 4′ diamonodiphenylsulphone)
Promin (5′-p-aminobenzene sulphonyl-2-aminothiazole)
Marfanil (p-Sulphonamidobenzylamine hydrochloride)

It is not necessary to discuss the relative merits and demerits of all these drugs. It would suffice to say that, on the basis of the pharmacological and clinical data that have been published, the seven drugs, sulphanilamide, sulphathiazole, sulphadiazine, sul-

phamerazine, sulphamethazine, sulphapyrazine and sulphaphthalidine, are the best available to treat all the infections amenable to the sulphonamides taken as a whole. It is to be noted that sulphapyridine has been replaced by sulphathiazole and sulphadiazine. Both these drugs are, to be preferred to sulphapyridine. Of these, three drugs, sulphadiazine, sulphamerazine and sylphamethazine, belong to the pyrimidine group, but there appear to be slight difference between their pharmaeological actions. Which of these is to be chosen or whether all the three are required, has not become yet clear. The drug sulphamethazine has been suggested to be of advantage for use in the tropics because this causes practically no renal complication. The methods of manufacture of sulphadiazine and sulphamerazine are very similar while that of sulphamethazine is different from the other two. So, in this note, sulphamerazine has been left out from consideration. Sulphapyrazine will indeed ba a very valuable drug but the method of its manufacture at reasonable prices has not yet been perfected. Promizole (which appears to displace promin and dissone) and marfanil have not yet established themselves in clinical practice; so, these have not been included in the list of the drugs to be manufactured immediately. The chances of discovering a sulpha drug distinctly better than the seven mentioned above with all-round advantages are indeed remote. In conclusion, the following five drugs should be taken up for manufacture :—

Sulphanilamide,
Sulphathiazole,
Sulphadiazine,
Sulphamethazine and
Sulphaphthalidine.

3. *Targets for Production.*—Because of the want of the requisite data it is difficult to calculate exactly how much of the sulpha drugs would be required to deal effectively with medical and public health problems of India. However, the target suggested, *viz.*, 500,000 lbs. per annum, appears to be reasonable. The exact quantities of the sulpha drugs produced in U. S. A. are as follows :—

1937	355,369 lbs. of sulphanilamide
1938	338,939 lbs. ,, ,,
1939	709,148 lbs. ,, ,,
1940	543,802 lbs. of sulphanilamide 102,196 lbs. of sulphapyridine 91,907 lbs. of sulphathiazole
1941	(figures not obtainable)
1942	5,434,427 lbs. of all sulpha drugs put together.
1943	9,860,333 lbs. ,, ,, ,,
1944	4,597,050 lbs. ,, ,, ,,

These figures should be carefully interpreted to calculate the requirements of India. We cannot extrapolate these figures on the population ratio between the two countries to arrive at the target of our production. The period upto 1938 were years of experimentation for sulphanilamide and the years 1939 and 1940 for sulphapyridine and sulphathiazole. The steep rise in production in 1942 is the result of the Pearl Harbour incident. In the years following, U.S.A. almost single-handed produced practically all the sulphonamides required for the armies of the Allies and the World market. In a way, the figure given under the year 1943 may be taken to indicate roughly the world demand. Competition from penicillin is being felt from the middle of 1944. When we take all these into consideration, the target of 500,000 lbs. per annum for the production of the sulphonamides is reasonable. The quantities of the individual drugs to be produced in accordance with the demand could be taken as follows :—

Sulphanilamide	100,000 lbs.
Sulphathiazole	100,000 lbs.
Sulphadiazine	150,000 lbs.
Sulphamethazine	100,000 lbs.
Sulphaphthalidine	50,000 lbs.

Patent position regarding the manufacture of these drugs in India.—

This is a very important question in undertaking the manufacture of the drugs. Fortunately, in the present case, the position is quite happy. The Haffkine Institute holds seven patents covering the processes of manufacture of the sulpha drugs and their intermediates. We can now undertake the manufacture of all the drugs we require by an arrangement with Haffkine Institute, which is a Govt. Institution.

The usual processes for the manufacture of sulphanilamide are not covered in patents so we are free to manufacture this drug. Regarding the manufacture of sulphathiazole two methods are commercially feasible. One of the processes is covered in India by two patents held by Messrs. May and Baker. The other process, which is of great advantage specially under Indian conditions, has been covered in a patent held by the Director, Haffkine Institute. Two more patents regarding an improved method of preparing the intermediate 2-aminothiazole are also held by the Haffkine Institute. The process of preparing sulphaguadine by condensing acetsulphanilyl chloride with guanidine salts is covered in India by a patent of the American Cyanamide Company (U.S.A.). The alternative process of preparing the same drug by treating sulphanilamide with dicyandiamide is open for exploitation, Sulphaguanidine as a drug for the treatment of the intestinal infection is effectively replaced by sulphaphthalidine. So sulphaguanidine has been left out from our list. Sulphaphthalidine is prepared very easily by treating sulphathiazole with phthalic anhydride. Two patents regarding the manufacture of sulphanilamidopyrimidine derivatives are held by the Haffkine Institute.

Thus, for the manufacture of the drugs contemplated, we need not depend upon the licence rights from foreign agencies. By an arrangement with the Director, Haffkine Institute, the manufacture of all the drugs required could be undertaken.

5. *Raw materials required and their availability.*—The question of the manufacture of the sulpha drugs of importance and the economics of the various processes, have been carefully studied at the Haffkine Institute, which has already made arrangements to produce about 8,000 lbs. of sulpha drugs. Based on this study, the raw materials required for the manufacture of the five sulpha drugs in quantities indicated, have been calculated to be as follows :—

Acetanilide	745,000 lbs.
Thiourea	115,000 lbs.
Guanidine nitrate	420,000 lbs.
Phthalic anhydride	26,000 lbs.
Pyridine (2°)	250,000 lbs.
Ethyl alcohol	600,000 lbs.
Methyl alcohol	100,000 lbs.
Acetone	250,000 lbs.
Ether (ethyl)	500,000 lbs.
Ethyl acetate	300,000 lbs.
Ethyl formate	200,000 lbs.
Sodium	80,000 lbs.
Chlorine	800,000 lbs.
Phosphorus oxychloride	670,000 lbs.
Zinc dust	700,000 lbs.
Calcium carbonate	700,000 lbs.
Decolorising carbon	5,000 lbs.
Chlorosulphonic acid	3,000,000 lbs.
Con. Hydrochloric acid	1,255,000 lbs.
Sodium Hydroxide	500,000 lbs.
Ammonia (as NH3)	30,000 lbs.
Total	11,246,000 lbs.

Of these items, ethyl alcohol, methyl alcohol, ether, chlorine, hydro-chloric acid, sodium hydroxide ammonia and calcium carbonate are available in India. One thing that requires to be emphasised and warned in the production of these raw materials in India is that much better attention has to be given as regards maintaining a standard quality and keeping the price at competitive levels. Some of the products prepared and supplied by the local manufacturers were found to be very disappointing in both these respects. The reason appears to be that the manufacturers are not able to adopt the modern and efficient methods of production for lack of suitable equipment but have to be satisfied with producing something with what they have got in a hotchpotch manner. The net result is that we have got to plan anew the production of the raw materials which can compete as regards quality and price with those available from U.S. A. or U.K.

Taking the prevailing market prices in U.S.A., the total cost of the raw materials listed works out to roughly 50 lakhs of rupees. Thus the cost of the raw materials for the manufacture of 1 pound of the sulpha drug, on an average, is Rs. 10.

6. *Equipment required.*—The manufacture of the sulpha drugs on the scale contemplated requires very modern equipment. It involves the handling of some of the most corrosive chemicals and some of the processes have got to be controlled with great care. The special type of equipment required will have to be imported from abroad. The following is the list of the special equipment required to undertake the manufacture:—

1000 gallons, jacketed, glass-lined kettle with stirrer	2
500 gallons, jacketed, glass-lined kettle with stirrers	20
50 gallons, jacketed, glass-lined kettle with stirrer	12
1000 gallons, open, single-shell glass-lined tank	20
Glass-lined condenser	2
500 gallons, stainless-steel jacketed kettle with stirrer	6
200 gallons, stainless-steel jacketed kettle with stirrer	6
1000 gallons, stainless-steel mixing tanks with stirrer	15
500 gallons, single shell stainless steel open tank	2
500 gallons, stainless-steel jacketed open kettle	3
Glass-lined storage tank, 5,000 gallons capacity	10
Washing type, open delivery, stainless steel filter press to hold about 200 lbs. of filter cake	10
Close delivery, stainless steel filter press, steam heated, capacity 20 gallons/minute	6
Centrifugal filters with stainless steel baskets	6
Steam Controls	50
Recording thermometeres	50
Stainless steel valves for kettles	50
Porcelain valves for kettles	50
Porcelain extension pipings	—
Stokes vacuum pump, 100 cu. ft. capacity	4
Drying chambers (110°), capacity about 250 lbs.	6
Acid resistant centrifugal pumps, 20 gallons/mt. capacity	10
Stokes BB2 tablet making machine	10
Oscillating granulators	10
Drying chambers	10
Mixers (500 lbs)	10

To this list is also to be added the cooling compressor to give cold water, steam boilers, air compressors and vacuum pumps to give steam, compressed air and vacuum lines respectively.

The total cost of the special equipment listed would be roughly rupees 20 lakhs. And the whole of this equipment will require to be imported.

7. *Number of units recommended and their location.*—From the point of view of economy, it is advisable to have a single unit undertaking the manufacture of the entire quantity of the drugs mentioned. By this there would be effected some saving in overhead expenses and economy in equipment also. But for strategic reasons, it is preferable to have two units located at two convenient places. Each of the units should be organised so that they can take up, at the same time, the manufacture of the sulpha drugs, atebrine and penicillin. By grouping the manufacture of these three drugs there could be effected some saving in over head expenses and also by way of equipment.

Regarding the sites to be chosen for the location of the plants, the main considerations are the availability of the cheap electric power and facilities for the transport of the raw materials. The largest amount of raw materials used fall under the category of acids and alkali. The plants should be located near the plants producing chlorosulphonic acid, hydrochloric acid, sodium hydroxide and chlorine. Thus we can save the transporting of nearly 3,000 tons of dangerous chemicals.

Further since the manufacture of the sulpha drugs involves the handling of large quantities of chlorosulphonic acid, phosphorus oxychloride and sodium the plants should be located in places where the humidity is not high and the rainfall also is not heavy. These considerations should be given careful consideration when locations are being selected for putting up plants for the manufacture of chlorosulphonic acid, phosphorus oxychloride and sodium. The site for making these chemicals and sulpha drugs should be the same, or they should be near about and easily accessible.

8. *Stages in which progress should be made.*—The production of 500,000 lbs. of sulpha drugs annually is indeed a very responsible job. In India there exists no pharmaceutical industry producing synthetic drugs worth mentioning. For the production of sulpha drugs in quantities mentioned batteries of units have to be set up. To start with, we can attempt to produce about a third of the target aimed at and when considerable amount of experience is gained, the units could be multiplied to turn on to full production. Provided there is no bottleneck by way of nonavailability of equipment or raw materials, in about two years the full quota could be realised. We have got at our disposal the experiences of the American industrialists who can, it is reported, switch on at any moment to produce 10 million lbs. per annum.

To start with, we need not wait for the raw materials to be manufactured in India. While the production of the raw materials is being planned and given effect to, the production of the sulpha drugs could start with imported raw materials.

9. *Approximate costs of manufacture.*—The price of raw chemicals (American market price) works out at Rs. 50 lakhs for the manufacture of 500,000 lbs. of the drugs. Overhead costs and depreciation will work out to about 10 lakhs at the most. Thus the cost per lb. works out to about Rs 12/-. We do not expect it to exceed Rs. 15/- per lb.

10. *How the industry should be managed.*—The manufacture of sulpha drugs (and penicillin) is pre-eminently an activity which must be under-taken by the States. Firstly because Government is in a happy postion that all the necessary patents needed are Government owned. And secondly because these drugs are required for the mass treatment of epidemics and other bacterial infections largely among the poorer sections of the community, they must be available at the lowest possible cost. In private produced drugs, the private profit is the largest element in the cost. It has been shown that sulpha drugs in quantities given above can be made at an average cost of about Rs. 15/- per lb. If these be bought from the market the average price would be about Rs. 65/- per lb. No better argument is needed for the State to take up manufacture.

11. *The nature of technical advice and the assistance required.*—The manufacture of sulpha drugs (penicillin and atebrine) can be very largely taken up under our own steam without technical assistance from abroad, if we proceed the right way about it. It will be particularly easy to do so, as it is recommended that the production should be undertaken by the state itself. A small panel of about 4 men, who are engaged in the manufacture of these drugs and have acquired considerable experience of their nature, should be sent to America to contact equipment manufacturers and the producers of raw materials. They should have the power tentatively to place orders for equipment and raw chemicals. This throwing open of business to these firms would enable our panel to see the working of the plants and would enable them to secure the technical assistance of the makers of equipment to give every assistance for the installation of the plant in India. This technical assistance would be adequate to undertake the manufacture. With such a large order, it may be expected these firms would even send out their technical staff to erect the plant. But we are quite clear that engaging of any technical personnel from abroad for a long time would be quite unnecessary. All that requires is to make up our minds to go in for manufacture and give our panel a certain amount of authority to contact firms with the definite object of making concrete plans. It is to be added that these drugs are of a type that must get the highest priority and we should proceed with the manufacture as rapidly as possible. These drugs (sulpha drugs, penicillin and atebrine) between them would take care of more than 3/4th of the major illnesses that occur in India.

APPENDIX III.

A NOTE ON THE MANUFACTURE OF MEPACRINE (ATEBRIN)

Dr. K. Ganapathi, D. Sc., & Lt. Col. S. S. Sokhey, I. M. S.

1. *Importance of Mepacrine.*—Malaria is the most serious of health problem of India. It is estimated by competent authorities that every year one hundred million attacks of malaria occur in India and a million deaths result from the disease. With the quinine source at our disposal *i.e.*, the quinine produced in India and imported from abroad, less than 1/8th of the cases of malaria received treatment at all. The rest remained un-treated. This urgent problem required immediate attention and cannot be met by any increased production of quinine in the near future, but fortunately we are no longer dependent on quinine. Atebrine (Mepacrine), which is an effective substitute for quinine, can be readily produced in sufficient quantities. Even when production of quinine is increased in India, atebrin will stay. Extensive experience gained during this war has shown atebrin to be distinctly superior to quinine in certain respects and has great advantages over quinine from a practical point of view. There is no doubt that atebrin has come to stay and if it is replaced at all, it will be replaced by a synthetic compound still more effective. Thus the production of atebrin should be undertaken immediately without any fear of the plant being thrown out of use.

2. *Target for production.*—The target of 500,000 lbs. per annum suggested for the production of mepacrine is reasonable. With this amount, we should be able to meet effectively the demands for the antimalarials. When Java was cut off and the Allied armies had to fight in the Eastern theaters of war mepacrine proved an effective substitute for quinine. The biggest supplier of mepacrine was the Winthrop Chemical Co. (U. S. A.), which in 1943, produced 466,406 lbs. of this drug and sold at $ 12.30 per lb. This quantity must have been largely used in the Indian, Burman and Pacific theatres.

3. *The Patent position.*—The process of manufacture of mepacrine is covered in India by a patent of the I. G. Farbenindustrie (Germany). The drug is now manufactured under licence rights granted by the Controller of Patents in his capacity as the Custodian of the Enemy Patents. The Haffkine Institute has been granted licence for the manufacture of mapacrine and has secured the raw materials and put up pilot plants for manufacturing about 3,000 lbs. of mepacrine. The purpose is also to study the comparative merits of the various alternative processes of manufacture that are possible. This study may evolve improvements in the process of manufacture.

4. *Raw materials required.*—The manufacture of 500,000 lbs. of mepacrine per annum is indeed a very responsible task. It is the most difficult of the drugs to manufacture, involving fifteen steps. It is also very exacting as regards the requirement of raw materials and special types of equipment. There are a number of alternative methods possible, which differ from one another as regards the requirement of special chemicals, equipment or application of particular reaction conditions. We have got to make up our mind as regards the processes we are going to adopt by surveying the raw materials which we can produce and the equipment we can obtain. The quantities of chemicals which may be required for the manufacture of 500,000 lbs. of mepacrine by two alternative processes have been calculated to be as follows.

Chemical.	Process I	Process II
Para nitrotoluene	450,000 lbs.	..
Acetanilide	..	750,000 lbs.
Pa-ra anisidine	300,000 lbs.	300,000 ,,
Phenol (Pure)	650,000 ,,	650,000 ,,
Diethylamine	255,000 ,,	400,000 ,,
Ethylacetoacetate	850,000 ,,	425,000 ,,
Ethylene oxide	275,000 ,,	200,000 ,,
Hydroxylamine hydrochloride ..	140,000 ,,	140,000 ,,
Acetone	1,850,000 ,,	1,850,000 ,,
Dichlorethylene	600,000 ,,	600,000 ,,
Butyl alcohol	1,400,000 ,,	1,400,000 ,,
Ethyl alcohol (absolute)	500,000 ,,	500,000 ,,

Benzene	250,000 lbs.	250,000 lbs.
Ether	500,000 ,,	1,000,000 ,,
Acetic acid	..	4,000,000 ,,
Chlorine	300,000 ,,	750,000 ,,
Phosphorus oxychloride	600,000 ,,	600,000 ,,
Thionyl chloride	..	600,000 ,,
Sodium metal	425,000 ,,	380,000 ,,
Copper sulphate	100,000 ,,	600,000 ,,
Sodium bisulphite	150,000 ,,	750,000 ,,
Sodium chloride	300,000 ,,	..
Sodium cyanide	..	600,000 ,,
Sodium dichromate	1,050,000 ,,	..
Sodium nitrite	200,000 ,,	350,000 ,,
Anhyd. Potasium carbonate	425,000 ,,	425,000 ,,
Potasium acetate	3,000 ,,	3,000 ,,
Sodium bromide	1,125,000 ,,	..
Anhyde. Calcium chloride	250,000 ,,	250,000 ,,
Copper powder	5,000 ,,	..
Iron filings	575,000 ,,	..
Decolorising carbon	10,000 ,,	10,000 ,,
Sodium hydroxide..	2,750,000 ,,	2,750,000 ,,
Con. Sulphuric acid	4,300,000 ,,	2,000,000 ,,
Con. Hydrochloric acid	2,500,000 ,,	4,000,000 ,,
Con. Hydrochloric aicd C. P.	500,000 ,,	500,000 ,,
Ammonium hydroxide (25%)	1,250,000 ,,	2,000,000 ,,
Total	26,333,000 lbs.	28,793,000 lbs.

Of the chemicals listed above, considerable amounts of the solvents, acetone, dichlorethylene, butyl alcohol, ethyl alcohol, benzene and ether could be recovered and used again.

We are not discussing here the number of problems that arise in the choice of the methods to be employed in the manufacture of 2 :4—dichloro—benzoic acid and the side chain. As regards these, two things we have got to keep in mind. In the first place, we should aiways prefer the method which, from the point of view of working, is safe and attended with the least amount of accidents and danger. Secondly, the chemicals and the intermediates to be handled should not annoy the workers and affect their health by constantly dealing with them for a long time.

The manufacture of 500,000 lbs. of mepacrine requires a good deal of coal tar products. For the preparation of para nitrotoluene required, we require about 100,000 gallons of toluene which is about 1/5 of the total production of toluene in India. In the alternative process, which is found to be attractive from the point of view of working, para nitrotoluene is avoided and acetanilide takes its place.

For the production of the quantities listed of acetanilide, phenol, para anisidine and diethylamine (which is to be prepared from diethylaniline to obtain a product of reliable quality), we require about 250,000 gallons of benzene.

The manufacture calls for large quantities of the solvents :—acetone, dichlorethylene, butylalcohol, ethyl alcohol benzene, ether and acetic acid, to the extent of nearly 5,000 tons.

Of the heavy chemicals, the production of sodium, phosphorus oxychloride and thionyl chloride requires to be organised for the first time in India. As regards others, the remarks made in the note on the manufacture of the sulpha drugs should be considered.

5. *Equipment required.*—The difficulty in the manufacture of mepacrine arises not because of the large number of steps to be gone through but because some of the steps involve processing operations that are hazardous to be undertaken on large scale. To

produce 500,000 lbs. of mepacrine we have got to handle nearly the equivalent amount o sodium or nearly half a ton of sodium per day. Some of the intermediate products are very irritating to the skin and mucous membrane. Before drawing up the plan, it is absolutely assential that the experiences of the manufacturers of mepacrine in U. K., U. S. A. and Russia should be carefully taken into consideration and the layout and equipment decided with the advice of all. This will save us a lot of trouble and avoid possible break-down. An attempt has not been made, therefore, to draw up a list of the equipment required for the manufacture of mepacrine. The nature of the equipment will be of almost the same type as those required for the manufacture of the sulpha drugs, but quantitatively it will be twice as much. Roughly, the cost of the equipmet will work out to Rs. 40 lakhs. Practically all of the equipment will require to be imported.

6. *The cost of production of mepacrine.*—On the basis of the latest American market prices, the cost of the chemicals listed for the manufacture of 500,000 lbs. of mepacrine works out to Rs. 90 lakhs. The overhead and running expenses per annum will be about Rs. 10 lakhs, so that for manufacturing 500,000 lbs. of mepacrine the total cost works out to Rs. 100 lakhs. Thus one pound of mepacrine will cost Rs. 20
The American price is $. 12·30 per lb.

7. *No. of units required and their location.*—As was recommended in the note dealing with the sulpha drugs, it is preferable to have two units to turn out the quantity of mepacrine contemplated. These two units should preferably be in the same place wherein the manufacture of sulpha drugs are to be undertaken. By this, there will be some saving in capital expenditure.

As regards the location of these two units, the same recommendations made as regards the sulpha drugs hold good.

8. *Stages in which the progress is to be made.*—Since the large scale manufacture of mepacrine is an extremely difficult task which requires very well-trained personnel to undertake, we should, start with producing about a tenth of the target and then gradually increase the production by multiplication of the units possibly in the course of five years.

9. *Nature of technical assistance required.*—The present is a very fortunate moment for taking up the production of mepacrine. We are reliably informed that the United States of America is stepping down its production and that certain plants will become surplus. We have the choice of visiting these plants and deciding for ourselves whether they would meet our purpose. This will have the further advantage that we will be buying machinery actually in working order and this will also enable us not only to buy the plant but also come to know of the actual details of production, because people who sell the plants will have to explain the issues. But this advantage can be gained only if immediate action is taken. For this purpose, as suggested in the sulpha drug note, a committee of 2 or 3 men who have actual experience of production and are not connected with commercial firms (the reasons for this will be given later on) should be sent abroad immediately to visit plants in U. K., America and particularly Russia. The Haffkine Institute was invited by the Russian Society Voks some time ago to send some workers to Russian plants that produce mepacrine and they promised to give every facility for practical learning of the methods of manufcture. This is a particularly attractive help and should be made use of. We are sure that we could get a group of chemists and others who are actually to run the plant and would be trained in Russia, if facilities were not available elsewhere. The thing would be to start with one plant with output of about 50,000 lbs. a year and use that both for training more men and deciding the best means of manufacture for further development.

10. *How this industry should be managed.*—Malaria is unquestionably a problem for the State to tackle, and so naturally Government should take up the manufacture of mepacrine. The drug must be made available to the health authorities at the lowest possible cost. And this can be done only by eliminating the private profit element.

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APPENDIX IV.

A NOTE ON MANUFACTURE OF PENICILLIN IN INDIA.

Dr. K. Ganapathi, D. Sc., and Lt. Col., S. S. Sokhey, I. M. S.

1. *Importance and Requirements of Penicillin.*—Penicillin is one of the most important drugs of the day and it has a wide application for the control of the infections due to gram positive bacteria. In addition, its value in the treatment of syphilis is proving to be of particular interest. At present, penicillin is not being widely used in India because it is not available, it is very costly and has to be administered by hospitalizing the patient. Only the rich are able to have the benefit of this drug. If we take it that roughly 4 million cases require to be treated with penicillin per annum, our annual requirements would work out to about 3,000,000 million units of penicillin. So far, penicillin is being given by injection every three hours round the clock to conserve the material which is both unavailable in large quantities and at the same time very costly. This administration of penicillin by frequent injections is one of the most annoying features of penicillin therapy and requires Hospitalization of the patient. So though 4 million cases may require penicillin, we, may not be able to treat this number for lack of hospital facilities at present. With the availability of more penicillin and at cheaper rates, the oral administration under suitable conditions would possibly be taken up. This method of administration would require about five to ten times the amount of penicillin to produce the same effect as obtained by injections.

To meet our future requirements, we should aim at producing about 1,000,000 million units of penicillin per annum. But we can make a small beginning and then gradually increase the production in the course of time. In fact the production of penicillin by 21 firms in U. S. A. started on a small scale, is increasing day by day in the geometrical progression as the following figures show :—

Month and Year.	Penicillin produced in U. S. A.	
June 1943	425 million units.	
July 1943	762 „ „	
August 1943	906 „ „	
.....	.....	
January 1944	12,550 million units.	
February 1944	18,726 „ „	
March 1944	31,192 „ „	
April 1944	74,964 „ „	50% of this produced by one firm.
May 1944	94,132 „ „	
June 1944	117,527 „ „	
January 1945	394,000 „ „	
February 1945	405,000 „ „	
March 1945	460,000 „ „	

In the course of two years, the production has increased by thousand times. In the year 1944, U. S. A. produced 1,663,300 million units of penicillin costing $, 35,000,000. In 1945, the production will be about 5,000,000 million units which will cost about $75,000,000. The price has also dropped down considerably ; from $ 20·00 it has come down to —$. 1·56 per 100,000 units.

The U. S. A. Government bought penicillin from the manufacturers at $ 0·56 per 100,000 units. The increase in production observed is not so much due to the expansion of the plants as by the improvements of effected in the methods of production. Of the 21 firms engaged in the production of penicillin in America, one firm alone produces 50%

of the total output. Chas Pizer & Co., has stepped up production to 175, 000 million units per month. In England, recently, a plant was erected at Spake near Liverpool at a cost of about £1,250,000 and with the capacity of 100,000 million units per month by the Ministry of Supply.

2. *Present fermentation method of production versus synthetic penicillin.*—So far, no method for synthesising penicillin has been found. But there is little doubt that, at some future date which may be the near future or decades hence, one will be invented and when that happens, Penicillin will naturally be produced synthetically. The present selling price of $ 11,250 per lb. of penicillin produced by the fermentation method would, very likely, fall to $. 500 per lb. when produced synthetically. This estimate is based on the fact that no synthetic chemical, however difficult and complicated the process of preparation may be, costs more tan $ 500 per lb. In this connection the example of thiamine is very illuminating.

In 1935, it was produced from rice bran and sold at $. 135,000 per lb., to day in U. S. A. about 50 tons are being manufactured synthetically per annum and are being sold at $. 80 per lb. Even riboflavin is being produced at the rate of nearly 60 tons per annum costing $. 100 per lb. The same thing quite possibly will happen to penicillin. This possibility is indeed quite familiar to all the producers who have put up penicillin plants but they do not appear to have headaches over this because the plants could be turned on for the production of other products of fermentation and also other biologicals. Economically, penicillin plants will never be a loss for the simple reason that plants costing 20 million dollars produce enough penicillin to be sold for 75 million dollars in one year. So far as the pharmacetuicals are concerned we should not allow future possibilities in other directions to shelve off immediate necessities, So, whatever will be the position in future if synthetic penicillin becomes a reality, we should not postpone undertaking the manufacture of penicillin by the present fermentation process adopted all over the world at present. Even if, in future, penicillin is likely to be superseded by some other synthetical just as the sulpha drugs have thrown prontosil into the background, our duty at present is to go with the manufacture of penicillin.

3. *The stages in which the production is to be organised.*—It is very necessary that we should turn on to full production of penicillin in India. But three important factors impose some limitations in our efforts. In the first place, the production of penicillin is a highly specialised task which involves the unique combination of the bacteriological, chemical and engineering techniques. Secondly, we require highly specialised types of equipment. Thirdly, we require large amounts of organic solvents and chemicals. Therefore, we should make a small beginning and go on expanding till we meet the demands. To start with, one plant with a capacity of about 10,000 million units per month should be erected. The capacity of the plant could be increased gradually and another plant also erected as the situation regarding the availability of plants and raw materials improves.

4. *The methods to be adopted.*—There are two methods of production of penicillin which are commercially practised, namely, the surface culture method and the submerged growth method. The first is the oldest and the safest one but the great draw back about it is that it is not suitable for productions beyond 10,000 million units per month. To produce this amount, we have got to work up every day 50,000 bottles, these have got to be cleaned, filled with the media, sterilised, inoculated incubated and the cultured fluid drained out asceptically.

The labour involved is enormous. On the other hand, the submerged growth method is well suited for the large-scale production and it is this method which is adopted by all the biggest producers. There is a great saving in labour but the engineering side takes the upper hand. We have to obtain huge fermentors which can work under aseptic conditions and also aerated without causing any contamination with the air-borne organisms. It is quite easy to step up production with this method. The Commercial Solvents Corporation (Indiana) uses fermentation tanks of capacities of 12,000 gallons. The plant of the Suibb and Sons also appears to be using fermentors of 15,000 gallons capacity.

5. *The raw materials required.*—To produce 1,000,000 million units of penicillin by the submerged growth process, the following chemicals are required in quantities mentioned:—

Lactose (Commercial)	1,500,000 lbs.	
Magnesium sulphate	20,000 lbs.	
Potassium dihydrogen phosphate	40,000 lbs.	
Sodium nitrate	240,000 lbs.	
Zinc sulphate	750 lbs.	
Acetone	1,200,000 lbs.	} Recoverable.
Amyl or butyl acetate	1,000,000 lbs.	
Chloroform	50,000 lbs.	
Phos-phoric acid (75%)	10,000 lbs.	
Sodium bicarbonate	20,000 lbs.	
Activated charcoal	300,000 lbs.	
Alumina (activated)	....	
Corn steep liquor (con.)	350,000 gallons.	
Bacto-peptone	500 lbs.	
Bacto-yeast extract	100 lbs.	
Agar	500 lbs.	

Lactose need not be of high quality and it is best made from the skimmed milk or milk powder by removing off casein. It could be substituted for a time by brown sugar or jaggery.

6. *Equipment required.*—Highly specialised types of equipment are required for the manufacture of penicillin. To produce 1,000,000 million units per annum, 25,00 gallons of the culture fluid has got to be made and worked up per day. Since the mould is allowed to grow under aeration for 3 days, at a time the plant should be able to accommodate nearly 125,000 gallons of the culture fluid in the fermentation tanks, the number and capacities of which have to be decided in consultation with the experts who have worked with them. The separation of the mould is made by filtration, the penicillin secreted is absorbed on activated charcoal which is separated by filtration, washed and then eluted with acetone or with other solvents. Now huge volumes of liquids representing one-tenth of the original have to be centrifuged with the aid of Sharples supercentrifuges. After purification by partition between solvents, the final product, after Seitz filtration, is to be dried by the lyophilic method. Without going into the number and quantities required, the equipment required is given below to give a rough idea.

Glass-lined fermentation tanks, fitted with heating and cooling coils, arrangement for blowing sterile air and temperature controls.

Sterile air generating equipment.

lass-lined stills

Centrifugal filters.

Plate and frame filter presses.

Sharples supercentrifuges (penicillin centrifuges)

PH. controls

Lyophilic drying equipment

Solvent recovery plants.

Bottle washing machines.

Bottle filling machies.

Bottle closing machnies.

'Toledo' printweigh' weighing machines.

Refrigerators kept at —40°C.

Air conditioners.

The cost for the erection of all the penicillin plants in U. S. A., which produce 5,000,006 million units of penicillin per annum has been estimated to be about 8 crores of rupees. The plant at Liverpool which is to turn out 1,200,000 million units of penicillin per annum costs about 2 crores of rupees. The cost of one plant with a starting production capacity of 10,000 million units will be about 25 lakhs of rupees. The quantity of penicillin produced by this plant at the present American market price, which is less than half the selling price in India will bring in a revenue of 75 lakhs. So the return even to begin with is much more than the initial investment. Instead of India buying penicillin from abroad, she can very well put up the plant and produce her own penicillin.

7. *How the Industry is to be managed.*—Penicillin is a product which took shape within a record time mainly because of Government encouragement and priorities. As a principle, the drugs that are of vital importance should be produced by the Government in as large a quantity as possible and at the lowest possible price. The American market price of penicillin which we have spoken of is 2/3 profit. The drug is sold to the public at $ 1·56 per 100,000, while it is sold to U. S. A. Government at 56 cents. It may be taken that private firms do not sell at a loss to Government. Thus, if the drug is produced by Government, the cost to the hospitals and other buyers will be about 1/6th of the present Indian selling price.

8. *Technical advice required.*—In the production of penicillin, there are a number of practical details that have got to be examined before deciding our methods of production. It will decidedly be not the correct procedure to contact some firm abroad and then request them to put up a plant or two here. The commercial production of penicillin is going on at a terrific rate in U. S. A. during the past two years and by now each firm engaged in the production has gathered a good deal of experience. The details of the growth of the mould, the methods of recovery of penicillin, the methods of drying adopted etc., are not exactly the same. Each firm adopts the method that suits its convenience as regards the availability of raw material and equipment. This individual difference in processes is reflected in the quality of the products put on the market some assaying 150 units per mg. of the dried material and some as high as 1200 units per mg.

The correct way for us to proceed on is to appoint a panel of competent men in the line to visit the various plants in U. S. A. & U. K. and Canada. also contact the War Production Board (U. S. A.) which has been subsidising a large amount of research in this direction and then decide, after carefully examining the information available and provided, which would be the best methods for us is India to adopt. Only after this, we should approach, through the panel, the prospective manufacturers of the suitable plants for getting equipment for our purpose. There is no use putting up plants in India on the discarded 1943 models.

APPENDIX V.

Some Recommendations regarding the manufacture of Sulpha Drugs, Mepacrine and Penicillin.

Dr. K. Ganapathi, D. Sc. and Lt. Col., S. S. Sokhey, I. M. S.

1. *The priority they should get for manufacture.*—The sulpha drugs, mepacrine and penicillin, are of very great importance for the treatment of the infections that afflict humanity. As pointed out previously these drugs can take care of nearly three-fourths of all the major illnesses that cause death and disablement in India. So, the production of these should get practically the first priority. The cure of infectious diseases come next only to the question of food.

2. *Two units for the production of all the durgs.*—It is recommended that these drugs be produced in two units, each of which would be a co-operation consisting of plants for the production of sulpha drugs, mepacrine and penicillin. The manufacture of these drugs requires the handling of large quantities of organic chemicals and solvents. The solvent recovery process to be carried out in the course of the manufacture of these drugs will practically be the same. The aim in clubbing the production of these drugs in one corporation is to save by way of capital and running expenditure, to have greater adaptability as regards turn-over and also to allow some degree of manouevre in chemical processes. A big unit is in a better position to stand the shock due to unfavourable economic situation and also withstand competition from outside. This is one of the main reasons why the small concerns are grouping into big corporations in America.

As regards the location of the two units, one could be located in the North and the other in the South in suitable places.

3. *The raw materials required.*—For the whole of the enterprise, the quantities of raw materials required to realise the full targets (*i.e.*, 500,000 lbs. sulphonamide, 500,000 lbs. mepacrine and 1,000,000 million units of penicillin per year) are as follows :—

	lbs.
i. Coal Tar Products.—	
Benzene	250,000
Acetenilide	1,500,000
Diethylanilihe	1,200,000
Phenol	650,000
Para anisidine	300,000
Pyridine (20°)	250,000
Phthalic anhydride	26,000
ii. Organic solvents and fine chemicals.—	
Ethyl alcohol	1,100,000
Methyl alcohol	200,000
Ethyl ether	1,000,000
Acetone	3,300,000
Butyl alcohol	1,400,000
Acetic acid	4,000,000
Chloroform	50,000
Dichlorethylene	600,000 (optional).
Ethyl acetate	300,000
Ethyl formate	200,000
Butyl or amyl acetate	1,000,000
Ethyl acetoacetate	600,000
Ethylene oxide	275,000
iii. Miscellaneous organic chemicals.—	
Thiourea	115,000
Guanidine nitrate	420,000
Lactose	1,500,000

iv. Inorganic heavy chemicals and miscellaneous chemicals.— lbs.

Con. Hydrochloric acid	4,000,000
Con. Sulphuric acid	4,200,000
Chlorosulphonic acid	3,000,000
Phosphoric acid (75%)	10,000
Sodium hydroxide	3,250,000
Ammonium hydroxide (25%)	1,370,000
Chlorine	1,550,000
Sodium	500,000
Phosphorus oxychloride	1,270,000
Thionyl chloride	600,000
Sodium bromide	1,125,000
Sodium nitrite	200,000
Sodium nitrate	240,000
Sodium cyanide	600,000
Sodium bisulphite	750,000
Sodium dichromate	1,050,000 (alter)
Potassium carbonate	425,000
Potassium acetate	3,000
Potassium dihydrogen phosphate	40,000
Copper sulphate	600,000
Calcium chloride	500,000
Decolorising carbon (activated charcoal)	400,000

4. *Economics of the processes.*—If we take the American market prices into consideration, we arrive at the following figures regarding the economics of the processes :—

	Rs. in lakhs.
The cost of all the chemicals required for the manufacture of the sulpha drugs, mepacrine and penicillin in quantities indicated	145
The cost of equipment, building and fittings to set up the two units	350
The running expenses of the two units	25
The cost of the drugs that will be produced by the two units taking into consideration the depreciation at 10% of the capital expenditure	205
The selling price of the drugs that will be produced on the basis of the American market (bulk) prices not including duty is approximately	820
The selling prices of the drugs on the basis of the present market prices in India is about	3,000

The above figures are given as rough indications for us to get an idea. Some of the figures have been calculated by the extrapolation of the quotations obtained in equipping the Haffkine Institute. The actual figures should be somewhere near this.

Throughout, we have taken the American market prices of the chemicals in calculating the costs. We are convinced that it is possible to produce the raw materials in India at competitive rates, if the Govt. takes it up and proceeds about in the right direction. The reason that has led us to this conviction is that even taking these selling prices in American market for the chemicals, we require for the manufacture of the sulpha drugs, mepacrine and penicillin, we may be able to produce the finished products on competitive levels. The figures justifying this have been given above which speak for themselves.

The drug industry should be started not merely for making India self-sufficient as regards her needs, but also to effect a great saving. What it would cost to put up the plants and run the units is much less than what it would to buy the drugs from the foreign markets. No better reason could be given to impress upon the necessity of starting this industry as early as possible.

5. *The stages in which the progress is to take place.*—The figures regarding the costs of chemicals and the units to be set up have been calculated to realise the full targets suggested. The full-scale production is to be realised in the course of ten to fifteen years and the production of these in India is closely linked up with the manufacture of the raw materials, and also the development of medical institutions to make use of these products. But an effective start can be made and production kept up with imported materials until the manufacture of the raw materials in India catches up the demand.

To start with we should plan to produce about one fourth to one tenth of the targets suggested and then increase production steadily as the position regarding availability of raw materials and trained personnel permit.

Under paragraph 11 in the Note on the sulphonamides, we have already stated how we should set about to plan the production of these important drugs. Before any executive action is taken, it will be necessary to produce more concrete and detailed plans which can then be passed on to the departments to undertake production. The drugs dealt with in these notes are of such vital importance that concrete plans, almost amounting to blue prints, should be prepared at the earliest possible and to this effect we have already referred to in the note on the sulphonamides.

APPENDIX VI.

The Shark-Liver Oil Industry.

Dr. V. Subrahmanyan and Mr. B. N. Banerjee.

A War-time effort that must be sustained in the interests of the country.

During recent years, a great deal of interest has centred round the production of shark-liver oil, especially on the West Coast of India. A useful volume of scientific literature has also grown up on the subject. The object of this contribution is to review the present position and to indicate some of the lines along which the industry should be planned and organised not only for meeting the post-war needs of the country, but also for holding its own against foreign competition.

India had once a flourishing fish oil industry.

The fish liver oil is no stranger to India. About eight decades ago, India exported quite large quantities to the West, Calicut being a big centre of production. Around 1870, the price of Cod-liver oil fell below that of the Malabar fish oil and the Indian industry practically died out for want of a suitable market. Cod-liver oil from Norway and other countries began actually appearing on the Indian market in increasing quantities and the country became more and more dependent on foreign supply.

The German invasion of Norway, followed by British blockade, practically cut off that country from the rest of the World. The subsequent submarine Warfare and the increased demands of the other nations kept India in short supply of cod-liver oil. Against this, the demands of the civil population and the fighting forces in the country for some suitable source of Vitamin A, became quite considerable. An alternative source had to be found and, under this stress, the Malabar fish liver oil industry was reborn.

The high Vitamin A potency of Indian Shark-liver Oil.

A great deal of credit is due to the Government organisations, as also the co-operating scientists, who helped to start the industry. It was soon established that the liver oils from the shark and the saw-fish has a much higher Vitamin A potency than Cod-liver oil. Occasional samples have potencies of several hundred thousand International units per gram, *i.e.*, well over 100 times the potency of standard Norwegian Cod-liver oil. The average potency is however, of a lower order, though still, distinctly higher than that of cod-liver oil. In some areas, an average of 30,000 units has been reported. In others, over 10,000 is found to be the average. We have examined genuine samples having a potency of between 5,000 and 6,000 units. A minimum potency of 10,000 units per gram has been suggested for the Indian Addendum to the British Pharmacopoeia and this may not be difficult to attain in practice. An oil of this standard will have about six times the potency of average Norwegian Cod-liver oil.

According to the latest International standard, the average daily requirement of an adult would be about 5,000 units of Vitamin A. The majority of people in India get very much less than this quantity in their food. A large section of the population would require between 3,000 and 4,000 units as a supplement to make the required minimum. The supplement has to come in the form of fish liver oils, Vitamin or carotenoid concentrates etc., but very few actually get them. The majority go without it, with the result that gross deficiency manifests itself in different forms. Early blindness, tuberculosis and other wasting diseases are some of the ultimate consequences of such persistent deficiency. Apart from the millions who are thus afflicted, there are several millions more who show a subnormal condition. In fact, it is generally recognised that there is more extensive deficiency of Vitamin A than that of any other Vitamin in India.

A target for production.

Granting that about 10% of the population of India is to receive a supplement of 2,500 units per day of shark-liver oil (possessing an average potency of 10,000 units per gram), the total requirement of the Country would be roughly a million gallons. If we make some allowance for the inevitable increase in population during the next decade and for an increased consumption by the people, the anticipated target of production would be about 2 million gallons.

The present production.

It is difficult to assess correctly the present production of the oil in India. Part of the production is under Government auspices and part through private enterprise. The oil is not usually marketed as such, but in a diluted form. The Government requirement (including the requirements of the Army) may be placed at a million pounds of Oleum Vitaminatum possessing an average potency of 1,500 units per gram. This would correspond to about 15,000 gallons of oil with a potency of 10,000 units. Some quantity has been exported outside the country, to China and elsewhere. In addition to this, there is the internal market of the country, but its off-take is not likely to have been so large as that of the Government. In fact, it is known that many of the big producers supplied their oil exclusively to the Government. Allowing a liberal margin for everything, it is unlikely that the present annual production of shark-liver oil from all sources could be very much more than 35,000 gallons. Even this may be an over-estimate.

There is evidence to show that all the oil is not derived from genuine shark or saw fish. The Governments and some of the reputed distributors are exercising some control, but the others are not so particular. We have examined specimens of oil containing only about 300 units per gram. These have subsequently been traced on the civil market, in a further diluted form, as standardised shark-liver oil. Such products are quite worthless and it is regretable that quite large quantities of these have been imposed on the already deficient civil population. This kind of thing is inevitable when there is no adequate drug control. At the same time, it must be remembered that even the lay public will not be slow in realising that they have not benefited by the use of such oils. There will inevitably be a reaction not only against the spurious brand, but other Indian makes as well, however genuine the latter might be.

It has already been mentioned that even genuine shark-liver oil may show considerable variation in regard to potency. This is due to a number of factors the most important among which are the season, the age and the size of the fish. The locality also seems to be a factor. The fish does not synthesize the vitamin, but only elaborates it from what it eats. The marine biologists have already collected a good deal of data bearing on these aspects; but in actual practice it is very difficult to apply them. The collecting and processing centres are far flung and it is not always possible to exercise the necessary control.

At the collecting centres, payment is made either on the basis of the weight of the liver or the volume of the oil. Both of these are defective. Payment should be on the basis of vitamin content, so that all concerned could aim at quality rather than quantity.

Indiscriminate fishing is harmful.

Some zoologists, keenly interested in the development of the industry, have expressed considerable apprehension in regard to the future chiefly because of the indiscriminate fishing that is going on. Even very young sharks, naturally, are being fast destroyed without any appreciable benefit. It has also been pointed out that the spawning seasons should be avoided for otherwise, the useful fishes will eventually disappear. It has, in fact been argued by some authorities that, at the present rate, it may be difficult to maintain even the existing supply. This may be undue pessimism, by any way the warning from such authorities has to be borne in mind when planning for the future.

The present methods require improvement.

At the present time, the industry depends largely on the efforts of fishermen who sell their material either to Government agents or to private contractors. The buyers either process the livers on the spot or, as more often happens to be the case, pack them in salt or other preservative and send them over to the factories for extraction of oil. Under the existing conditions, freezing would not be feasible. Even salt preservation should prove adequate, provided there is not much lapse of time between the catch and the preservation on one hand and preservation and extraction on the other. Normally putrefactive changes set in rapidly, liver being very readily attacked. The changes are naturally very rapid under the warm tropical conditions. Added to this, the liver is a store house of digestive ferments which, though classed as non-living, can yet produce very profound changes even

in presence of the salt. Under the existing conditions, it is not uncommon to find a lapse of one to two days between different operations. This should be regarded as being too long. The oil increases in acidity, and putrefactive matter accumulates in the medium. On extraction, the oil is more smelly than it need be ; it also tends to go rancid on standing. The vitamin is also steadily destroyed, so much so, that under certain conditions, the oil becomes quite useless.

Need for protecting the vitamin.

The destruction of vitamin A in shark-liver oil has been studied carefully. The factors mentioned in the foregoing paragraph are very important in determining the rate of destruction. There are also other factors such as the nature of the container, diluent used, temperature, exposure to light, access to air and moisture and so forth. Even with the greatest care, it would not be possible to completely avoid destruction of vitamin. It is considered necessary, therefore, to add small quantities of protective agents (anti-oxidants) some of which are extremely potent in their action. Several anti-oxidants are mentioned in literature. Most of them are quite harmless at the concentrations to be used. They can be used singly or in certain combinations ; in the latter case, the beneficial effect is disproportionately increased (synergistic action). With such protection, the vitamin will remain stable for some years during which period the oil may be reasonably, expected to be consumed.

The use of anti-oxidants as vitamin A stabilisers is well known and extensively used. Many of the well known brands of Cod-liver oil preparations owe their substained quality to the use of such protective agents. Some imported brands do not of course contain them, with the result that their vitamin contents are not what they are claimed to be. In the interests of the Indian industry, it should be definitely made a policy to recommend and to insist on the use of the least harmful and the most effective among anti-oxidants.

The methods of collection and processing do of course require a good deal of improvement. Under the existing conditions, it will be difficult to introduce some of the improvements. If sufficiencly big vessels could be used and if the livers could be extracted on the vessels themselves as is generally the case in the preparation of cod-liver oil—a great deal of the subsequent difficulty could be avoided. Alternately, vessels fitted with refrigerating equipment could be used. This will require State support and organisation.

Potentialities are considerable.

India has a very long Coast line amounting to several thousand miles. Of this, only small part is actually being used for shark fishing. The possibilities of the rest of the coast —especially on the East—as also the use of other kinds of fish should be carefully studied. There will of course, be need to blend, but as long as this is done under proper scientific supervision, no harm will follow.

Even with proper organisation, it is too much to expect that the target of one million gallons a year can be attained in the near future. The supply of fish may not be adequate unless very special precautions are taken. In this again, state organisation will be needed.

Fish liver oil is the most potent source of Vitamin A. In a country like India, with its large vegetarian population, fish liver oil may not be acceptable to all. A considerable section of even strict vegetarians especially in South India—have no objection to the use of fish liver oil as a medicine. Even these would prefer a vegetable source, if available. The Jains and certain other communities have very strong objections to fish oils. In any case, fish liver oils will not meet the entire country's need. The carotenoid pigments from vegetable sources must definitely be made use of to supplement the fish liver oil. This is another major problem, but as it is not relevant to the present theme, we will now revert to further consideration of fish liver oil problems.

Shark-liver oil requires supplementing with Vitamin D.

The Cod-liver oil is naturally rich in Vitamin D. In that oil vitamin A and D are so proportioned that no further supplementing is needed. In the case of shark-liver oil vitamin A is very predominant, so that further supplementing of vitamin D will be needed to render it more balanced. Fortunately, concentrated Vitamin D preparations like calciferol are easily available at relatively small cost so that it should not be difficult to

supplement shark-liver oil with Vitamin D at the blending centres. Considering the importance and the inter-relation between these two fat-soluble vitamins, it should be made a State policy to insist on the supplementing of shark-liver oil with Vitamin D before marketing.

Vitamin E is another important fat-soluble vitamin. It is not however very much missed in the average Indian diet which includes a good proportion of vegetable oils, whole seeds and so forth. It may not be necessary to add this vitamin to fish-liver oils, though it may indirectly help by acting as a stabiliser. In the case of carbotenoid concentrates however, the presence of this vitamin is considered necessary both as a stabiliser and as an auxiliary for the better use of the vitamin.

Shark-liver oil need not be diluted.

During the first few years of the shark-liver oil industry, it was considered desirable and necessary to dilute the vitamin A content to the same level as in Cod-liver oil. Groundnut oil was largely used for this purpose. This practice led to a number of secondary difficulties. It also facilitated the marketing of a number of spurious products. A good section of people find groundnut oil disagreeable; they do not use it even for cooking. Taken on the whole, it is now being increasingly felt that there is no need to dilute the shark liver oil. The concentrated product can be used as such, the dose being reduced in proportion to the concentration used in that manner the oil will also be less disagreeable. That is how halibut oil, another rich fish-liver oil is being used throughout the world.

Molecular distillation may not be necessary.

Even when used in drops, any fish-liver oil has a disagreeable smell. Several ingenious methods for taking such oils along with food have been suggested, but even then, the more fastidious people cannot miss the smell. It has been suggested, therefore that the vitamin in the oil should be concentrated free from smell. This is a very desirable object, but there seems to be some practical difficulties in the way. The possible of molecular distillation employed for the separation of the vitamin is well known and there are a number of small stills in different parts of the World. There seems to be only one big still however (in America) which is actually being used for the distillation on a commercial scale. The erection of such a still at some central place in India may not be feasible unless collaboration, a comparatively favourable basis can be established.

Suitable packing will get round the smell problem.

Modern methods of packing have been steadily getting round the difficulty of smell. Today there are several brands of vitamin preparations on the market which are so pleasantly coated that the smell, if anything, is quite agreeable. Such vitamin preparations which often include a number of vitamins—can be swallowed without any discomfort. There is also no unpleasant after smell. If the same pleasant smelling capsules are bitten through, the strong smell of the fish oil can be noted. Judging from the smell and concentration of the vitamin, it is easy to make out that either halibut oil or shark-liver oil of the necessary high potency is being used. Molecular distilled, odourless vitamin is still not being used on a large scale even by the most reputed firms. If proper methods of packing are employed, the smell difficulty can be completely eliminated even when using the raw fish oils.

Even with the present methods of production, it should not be difficult to collect together substantial quantities of shark-liver oil having an average potency of 30,000—40,000 units per gram. Of such an oil, only about a drop will be required for meeting the daily supplementary requirements of an adult. If the calculated quantity can be properly packed in attractive capsules, the entire needs of the more fastidious section of the public can be easily met. In addition to this, there will always be the less concentrated product the daily dose of which will be a few drops. This can be easily taken if suitable dropping arrangement can be provided.

Difficulties in the way of the healthy development of the industry.

Judging from the trends of recent years, the biggest obstacle in the way of healthy organisation and scientific development of the industry is the existence of a number of independent bodies, which work rather isolated from each other. Provincial Governments, States, manufacturing concerns and others all work without sufficiently close contact with each other. Though it is not openly expressed, there is also a feeling of unnecessary rivalry with a tendency to observe secrecy in regard to the experience collected by each organisation. As the result of this, there is no useful exchange of ideas between some of the major organisations. Each organisation has its own separate agency for advertising, marketing, etc. This state of affairs stands in the way of healthy development. It also provides scope for the less scrupulous section of traders—who are under no control—for marketing all kinds of products as genuine articles. For want of proper co-ordination and concerted effort, the reputation of the industry as a whole, is suffering. Even patriotic minded medical practitioners are now hesitant about recommending Indian Shark-liver oil. Doctors with some professional reputation are very zealous about guarding them, they are naturally inclined to be conservative in the recommendations to their clients. Patriotic considerations cannot weigh much in the alleviation of suffering. The present position should therefore be realised in its proper perspective. The Norwegian Cod-liver oil (with its high reputation) and other well known brands will soon be on the Indian market and unless the shark-liver oil industry will unite in facing this competition, it will soon die again—just as the Malabar fish-liver oil industry died about 80 years ago. *Instead of expanding, the indsustry is in danger of extinction and it is earnestly hoped that this common danger will bring all the diverse elements together and pave the way for organised planning and development.*

There is no need for any secrecy.

At the heads of different provincial or state organisations there are administrators. These are naturally guided by their technical staff. The technical staff are inclined to keep rather close and this has created even in the minds of the administrators, the impression that there is something of a specialised nature which must be preserved confidential for the benefit of their unit. *There is in fact no need for the preservation of any secrecy in regard to the methods of production and stabilisation.* The really important factor is the supply of fish liver and if the fishing areas can be properly demarcated there is no aspect regarding which any secrecy need be maintained. In the interest of all concerned, there should be free exchange of notes. There should also be unified control to see that proper methods are followed. The standardisation and marketing can also be under joint auspices. No interest will suffer under such conditions. Fraud will be stamped out and the industry will flourish under healthy conditions. The industry can also present a unified front to secure the necessary measure of protection against unfair foreign competition.

A central, co-ordinating authority is needed.

As already mentioned, the production is now going on under diverse auspices. These are not normally likely to meet unless the Central Govt. takes some initiative in regard to the matter. Even when they meet, they should do so with a determination to work together.

Independent organisations cannot exercise any effective control unless they decide to create a Central authority. The Central authority should command their full confidence and at the same time, have necessary freedom to plan and carry out the future development.

An outstanding instance of success through a central organisation is the well known development of the Tennessee Valley. A number of independent states were involved and if they had proceeded independently nothing would have been done to this day. The development of the valley was made a Federal subject and a Central authority was created. The result is the outstanding success which stands as an example to the World.

Composition of the proposed Central Authority and their powers.

For the development of the Shark-liver oil industry, what is needed is a small Central Authority consisting a highly experienced administrator who will also represent the Government, a reputed member of the industry, who will advise on all business matters and one scientist with the requisite standing and experience.

The Authority which would work whole-time should be charged with the planning and development of the industry for the whole country and they should be given the targets with full powers to take the necessary action. Every province or state with a coast line should come under their purview. After organising production, the share of benefit for each individual province or state can be easily determined. The work of the Authority can be periodically reviewed by a bigger organisation.

The Central Government has taken up the planning of the major industries of the Country. The plans are now being drawn in big broad outlines without actually going into details. The details are however necessary for the execution of each plan and lacking them, the plans will remain vague and unexecuted.

The present note does not claim to be a plan. It only aims at taking the position a step beyond the fixing of a target. It draws attention to some of the outstanding problems and suggests a way of dealing with them. A specialised whole-time body such as the proposed Central Authority is needed to go into further details and to draw up the detailed plans to execute them. The planning and execution need not be separated.

Each item of industrial development would require such whole-time planning and execution. The planning organisations should also have the necesssary powers and freedom to execute their plans. If their work stops merely with sending reports, there will be no progress.

If the Central Government is to plan the wholesale development of industries, hundred of such organisations will be needed. This will mean a huge expense for even a very prosperous country. The available talent is also very limited. A beginning can however be made straightaway with subjects like the present one where the industry already exists. Moreover, as already pointed out, the industry is in lively danger of foreign competition which may ultimately kill it. In such a case, immediate action will be needed. All technical and other difficulties should be overcome and the industry should be not only protected but also considerably strengthened.

In the preparation of this note, great care has been taken to avoid specific reference to any individual or organisation. There may no doubt be some difference of opinion in regard to matters of detail, but the main problems are all these and they must be satisfactorily solved if the industry is to live and to flourish in the post-war period.

APPENDIX VII

A NOTE ON THE MANUFACTURE OF VITAMIN A CONCENTRATE FROM SHARK LIVER OIL.

Dr. K. Ganapathi. and Lt. Col. Sir S. S. Sokhey.

1. *Importance of Vitamin A.*—Vitamin A is one of the important vitamins and it plays a significant role in the nutrition of the children and adults. Deficiency of this vitamin retards growth, causes night blindness and xerophthalmia, and lowers the general resistance towards infection. It is very vital for children. They should receive this vitamin daily in adequate amounts in their diet. Milk and vegatables, particularly the green and leafy ones, are the normal sources of this vitamin. In addition, it is the practice in the case of children to supplement this source by fish liver oils rich in vitamin A. Because of the critical food situation prevailing in this country as a result of war, a great deal of sicknesses and other diseased conditions traceable to the deficiency of this vitamin have become prevalent. The supply of this vitamin has become one of the important problems for the Government to tackle. We require vitamin A not only for treating those who suffer from the deficiency of this vitamin but also making it available for all children upto the age of 16 years in adequate quantities for their normal growth.

2. *Quantity of Vitamin A required.*—We can take it then that ten per cent. of the population in India require vitamin A to be administered daily. The daily requirements of this, as laid down by a recent authoratitive recommendation, varies from 1,500 to 5,000 international units. Children up to the age of 10, pregnant women and lactating mothers require about 5,000 units per day. Certain amount of Vitamin A is usually taken along with the diet and we have to supplement it by extra amount where the quantities of vitamin A taken is not enough. It is the opinion of many that the children should be administered daily about 2,000 units of vitamin A irrespective of their dietary intake. So if ten percent. of the population has to be administered daily 2,000 units of vitamin A, our annual requirement of vitamin A for this purpose works out to about 30,000,000 million units.

3. *Materials.*—Vitamin A is widely distributed in the vegetable kingdom, but it occurs in a much greater concentration in some fish liver oils, particularly so shark liver oil. We are fortunate in having a long sea coast which abound in sharks yielding liver oils of high petency of vitamin A. The extraction of the vitamins from these liver oils is much easier than that from the vegetable sources. Becuase of these important reasons, the shark liver oils become the main and cheap source of vitamin A for us. Shark liver oil, even if manufactured with utmost care, possesses some disagreeable odour and taste. But the vitamin fraction free from this odour can be separated out from the oil by chemical methods or much better by molecular distillation. Such a vitamin fraction obtained can, if required, be flavoured to any desirable degree and also be blended easily into any composition to furnish an attractive preparation.

4. *Quantity of Shark Liver oil required.*—The bulk of the shark liver oil available to us are of average potency of about 10,000 units of vitamin A per gm. The preparation of the vitamin concentrate from the oil involves a slight loss. So to prepare 30,000,000 million units of the vitamin A concentrate, we need roughly one million gallons of shark liver oil of average of 10,000 units of vitamin A per gm. We are not able to obtain reliable figures for the present production of the shark liver oil ; however, the director of Fisheries, Bombay, informs us that the total production of shark liver oil in India would be about 30,000 gallons per year. Considering the present state of the industry and the anormous scope there is for improvement and expansion, we are convinced that it would be possible to reach the target of one million gallons per year if this industry is properly organised. We have disucussed this question with the Director of Fisheries, Bombay, and he agrees with our views.

5. *The Production of Shark Liver Oil*—At present, the production of shark liver oil is going on under the auspices of some Government Departments and also some private agencies. The most important single step in the production of the oil governing the quality and vitamin A potency of the oil, is the extraction of the oil from the fresh livers under scientific control. This process of extraction must be conducted on much more scientific and modern lines. To put this industry on a firm basis, the Governments of Sind, Baroda

Bombay, Madras and Travancore should co-operate with each other and then strengthen their Fisheries Departments. With the labour available in India which is cheap compared to the Western standards, the abundance of sharks in our waters which yield oils of high vitamin A potency, and requiring no chemical to be imported for the extraction if the oil from the livers, we can be confident that this industry, if properly organised, should be able to withstand competition from any part of the world.

6. *The price of Shark Liver Oil.*—It is difficult to make an estimate of the actual cost of the shark liver if manufactured under Government control without private profit element. The present market prices give no indication because we do not know the degree of profit involved. However, the Haffkine Institute is buying shark liver oil from the Department of Fisheries of the Bombay Government and the prices are as follows —

Potency of Oil Units of vitamin A per gm.	Price per gallon. Rs. As. Ps.
10,000	20 0 0
15,000	23 12 0
20,000	30 0 0
25,000	32 0 0
30,000	35 0 0
40,000	37 8 0

It can be seen that the price is not proportional to the vitamin content. The bulk of the oil obtainable possesses an average potency of 10,000 units per gm. and we will here take only this brand of oil into consideration tentatively. On the basis of the price paid for the oils of potency of 10,000 units per gm. the price of one million gallons of shark liver oil works out to two crores of rupees. So an industry with such an amount of turn over should be put on a modern and proper basis and can claim a greater degree of attention from the Governments.

On the basis of the price of the oil of potency of 10,000 units per gm., the price of 1,000 doses of shark liver oil each containing 2,000 units of vitamin A, works out to roughly Rs. 1-2-0; thus the quantity required by one individual per year costs about Rs. 0-C-6.

7. *Preparation of Vitamin A concentrate by molecular Distillation.*—There are two methods of obtaining vitamin A concentrate from the shark liver oil. The one is by chemical processes and the other is by molecular distillation. The first process has been well investigated in the Haffkine Institute and is actually being used. But we do not recommend this as the best one for the following reasons :—In the first place, to concentrate one million gallons of the oil, chemicals costing about Rs. 35 lakhs are required ; besides a good deal of equipment. In the second place, the vitamin A fraction represents just five percent. of the bulk of the oil and to recover this, we destroy the rest of the oil by converting into the calcium soaps. Thirdly, during the process of saponification, the vitamin esters of the oil are converted into the free alcohol which is less stable than the esters. Molecular distillation avoids these three drawbacks.

By distilling the shark liver in a molecular still, the oil can be stripped off its vitamin fraction which is obtained in a very clean and attractive form free from the objectionable odour and taste. The bulk of the residual oil representing about 80 per cent. of the original volume is also rendered odourless by the process and this is available for feeding and also other industrial purposes such as for the leather industry, preparation of turkey red oil, paints, dopes etc. Vitamin A obtained from the shark liver oil by industrial distillation exists in the ester form along with the tocopherol fraction, which is the stabilising agent of vitamin A in the oil. Because of these reasons, molecular distillation of the oil has been taken up in U. S. A. The Industrial method consists in the distillation of the oil in the centrifugal rotating plate stills under very high vacuum. In 1936, when molecular distillation on an industrial scale was still in its infancy and was being carried out on a pilot plant scale, enough vitamin A esters were produced to meet a tenth of the entire demand in U. S. A. Even this pilot plant could distil about 100 gallons of the oil per day. Today, in the Laboratory of the Distillation Products Inc. (Rochester), there is in operation a unit consisting of a battery of 21 stills of 32 inch plates exclusively for the distillation of fish liver oils. With this in 1943, nearly 5 million pounds of shark and pollack liver oils were distilled. Recently, the Distillation Products have been experimenting with the construction of higher stills. The rotating plate still of 60 inch constructed has a capacity of 500—1000 lbs. of oil per hour. Another still is said to be under con-

struction which can distil an even larger quantity of the oil per day. This shows that it is quite easy to subject the entire quantity of the shark liver oil produced in India to molecular distillation.

Molecular distillation is comparatively a cheap process. The recurring expenses consist mainly of the cost of power required to drive the stills. To distil one million gallons of the oil in the stills of the type recommended below, the total expenditure, including the depreciation on the capital ; will be about 6 lakhs of rupees, it will not in any case exceed 10 lakhs of rupees. The cost of the vitamin fraction obtained from 1 million gallons of shark liver oil (of average potency of 10,000 units per gm.) will be 210 lakhs of rupees. So 1000 doses of vitamin A concentrate of 2,000 units each obtained by this process will cost about Rs. 1-6-0. There is then the income from the residual oil. By distilling one million gallons of the shark liver, we will be left with about 800,000 gallons of the residual odourless oil. Even if disposed of at Rs. 2/- per gallon, this residual oil will fetch an income of Rs. 16 lakhs.

8. *Number of Molecular Distillation units required and their location.*—To concentrate about one million gallons of shark liver oil per year we require a battery of stills. It is better these stills are put in the five localities wherein the shark liver oil will be produced. If we have one centralised unit, all the various stations along the entire coast producing the oil have to send the oil to this place and then take back the processed products from here. This will involve considerable expense and also inconvenience by way of transport. So, each of the Fisheries Departments of the five Governments concerned, can have one molecular distillation unit with a capacity to distil about 400—600 gallons of oil per day. These units could be located at Karachi, Baroda, Bombay, Calicut, and Trivandrum. Initially, we may not produce enough oil to engage the five units. The quantity of oil produced at present can be distilled by one unit alone. So to start with, we should obtain one unit and locate it at either Bombay or Calicut, which produce at present the largest quantity of the oil. As the production of the shark liver oil increases, we can gradually have the units in the other places also.

9. *Cost and Availability of the Molecular distillation units.*— The process of manufacture of the vitamin A concentrate from the liver oils by the "short-path" distillation method (Molecular distillation) is covered in a patent owned by the British Drug Houses. It is anticipated that there will be no difficulty in obtaining licence. This firm has agreed to grant the Haffkine Institute the licence rights. The molecular stills of the industrial type we require are manufactured by the distillation Products Inc., Rochester, at present and we can obtain the stills only from this firm. Two years ago, the Haffkine Institute approached this firm for a rotating plate still with a capacity of about 50 to 75 gallons per day. But because of the abnormal world situation prevailing then, this firm could not fabricate this unit at that time and informed us that this matter be taken up at a later date. A unit with a capacity of 50—70 gallons per day costs about Rs. 80,000 while a bigger one with a capacity of about 400 gallons per day costs roughly Rs. 1,50,000. We require units of the latter type for each of the Fisheries Centres proposed. So all the five units will cost about Rs. 7,50,000. To negotiate this transaction successfully, a body with the technical and administrative experience and with the authority of the Government should contact this firm and then decide upon the terms of contract and the types and designs of the stills. We do not anticipate any difficulty in this. This should be done at any cost in the interests of India. We, who have got to bring practically everything anew in the industrial field, have an opportunity to start with upto-date equipments and processes. These molecular distillation units will not only be furnishing us with what we want but also serve the purpose of educating others in this important and useful modern process which has got great possibilities in India.

10. *How this industry is to be managed.*—The supply of vitamin A concentrate is an activity that must be undertaken by the state. This concentrate must be within the reach of all the poorer sections of the community and so this should be as cheap as possible. Comparing the cost of vitamin A prepared from shark liver oil as given under para. No. 7 with the market price of the preparations manufactured by the private firms, we arrive at the conclusion that the manufacture of shark liver oil and also the preparation of the vitamin A Concentrate by molecular distillation shall be under state control.

APPENDIX VIII

NOTE ON TARGETS FOR FINE CHEMICALS.

(Dr. J. N. Ray.)

Phenatidine	It is an important chemical not only for the drug industry but has its use in other industries. Therefore, a target of 200 tons would seem to be justified.
Phenacetine	Target 50 tons. It is for the medical members of the Committee to find out whether this is a correct estimate. Judging by the pre-war consumption I should think 50 tons to be quite reasonable.
Resorcinol	Used in the dyestuff industry. Simple dyes like rosin are prepared from this. Hence 25 tons target was suggested.
Cresols	Judging by the amount of consumption of saponified cresol lysol in this country, a target of 1,000 tons is not unreasonable.
Xylenol	Used for the preparation of dettol type of disinfectants. Xylenol is to be converted into chloroxylenol and then into dettol type of disinfectants. The target can be reduced if the medical members feel that India cannot use 5,000 tons of dettol type of disinfectants. (500 tons of xylenol will give approximately 5,000 tons of these disinfectants).
Acetic anhydride	Dyestuff industry needs 100 tons. Target suggested is 250 tons. Acetic anhydride would be considerably used in the rayon industry, whose requirement would be another 100 tons. The balance would be readily absorbed by the drug manufacturers.
Benzaldehyde	This is used in the perfume industry, as also in the manufacture of dyestuffs. An immediate target of 20 tons is quite a reasonable quantity to adopt.
Phthalic acid	This would be required for glyptal type of resins. We have 1,000 tons of naphthalene in surplus production and every bit of it will have to be converted to phthalic acid, because its use as an insecticide does not consume the whole quantity. I think 100 tons should be our immediate target.
Agar	Pre-war consumption between 2 to 3 tons. Immediate target 10 tons. There is likely to be an increased requirement due to improved health services.
Citric acid	Aerated water industry used nearly 200 tons. Extra amount provided is for Health Services.
Monochloro acetic acid	Required for the preparation of various synthetic drugs like Adrenalin and also for weed killers. Target of 100 tons is very modest.
Stearic acid	Required for shaving sticks, cosmetics, anti-mosquito cream, vanishing creams. Normal consumption about 200/300 tons. Target 1,000 tons.

Barium Peroxide	..	100 tons—based on a requirement of nearly 50 tons of hydrogen peroxide.
Calcium and Sodium	..	The target will have to be calculated on the basis of the target fixed for anti-malarial drugs.
Activated Carbon	..	250 tons—both for medicinal and decolourising purposes. The requirements of the sugar industry has also been taken into account.
Starch	..	Present production about 300 tons. Required for cosmetic industry, medicines and in textiles. Target for 1,000 tons very modest quantity.
Camphor	..	Required for celluloid industry and also for medicines. The requirement of celluloid industry is very large.
Glycerine	..	Present production 2,000 tons. Target set 4,000 tons. Required for endless number of items.
Formaldehyde	..	Required for the plastic industry. Medicinal requirement about 100/150 tons.

APPENDIX IX.

SOLVENTS.

(Dr. J. N. Ray).

If India is to produce fine chemicals and synthetic drugs, the most essential requisite is that India should have a well organised solvent industry and solvents should be available at a cheap and reasonable price.

The following are mostly in the fine chemical industry:—

1. Alcohol (ethyl)	2. Methyl alcohol
3. Acetone	4. Acetic Acid
5. Ethyl acetate	6. Butyl Acetate (amyl acetate)
7. Ether	8. Chloroform
9. Carbon tetrachloride.	10. Vynyl acetate
11. Chloroethylenes	12. Glycol & Glycol esters
13. Furfuryl Alcohol	14. Carbon bisulphide
15. Sulphur chloride	16. Benzene
17. Toluene	18. Nitrobenzene
19. Xylene	20. Pyridine
21. Dioxan	22. Glycerine.

Alcohol.—India's requirement of alcohol for medicinal purposes so far as Defence Services and Government civil demands are concerned has been approximately 100,000 gallons per year. The country's total requirement on this basis will be approximately one million gallons per year. If the industries expand as has been visualised in the first meeting of the Fine Chemicals, Drugs & Pharmaceuticals Panel, then it is proposed that we should have a production target of 10 million gallons of alcohol for various purposes, to be attained during the next 15 years. At present the production of acetone and methyl alcohol is extremely limited. A certain amount of acetone has been prepared in the Ordnance Factories from ethyl alcohol and a small amount has been produced by Messrs. Bhadravati Iron & Steel Works. We feel that the production of methyl alcohol and acetic acid from Wood is not going to be an economical proposition. India should aim at a production target of at least 100 tons of methyl alcohol per annum increasing it as industries get established. With regard to acetone, its employment in the lacquer industry is its principal outlet at the present moment. Acetone is also used as a solvent in the drug industry but the total amount used by the drug industry is only a small fraction of its employment in other directions. Therefore, in formulating plans for the production of acetone, other panels connected with the subject should be consulted.

Acetic Acid.—The present production of acetic acid is negligible. Acetic acid will play an important part in the development of the pharmaceutical industry and also will act as a starting material for the preparation of acetate type of solvents such as vynyl acetate, ethyl acetate, butyl acetate. Here again the total production target should be fixed in consultation with other panels but in my opinion we would not be wrong if we set a target of at least 1,000 tons which India would be able to consume immediately. The production of acetic acid via the oxidation of alcohol is the route to be chosen as wood distillation would not be a success except in such parts of India where there is a demand for wood charcoal. With plentiful supplies of alcohol available at a cheap price, the production of acetic acid by oxidation of alcohol should be a commercial proposition.

Acetate Solvents.—Acetate type of solvents such as ethyl acetate, butyl acetate, will be required only in small amounts in fine chemical industry, the principal amounts will be consumed elsewhere. In my opinion, taking all demands into consideration, we should aim at a production of 1,000 tons of acetate type of solvents immediately.

Ether.—We have already stated in the first meeting of the Panel that ether is not a suitable solvent of choice in India owing to high climatic conditions involved. The country's requirement of ether anaestheticus is roughly about half a million pounds per annum. The capacity exists in India. We would not be justified in putting a production target for ether as this solvent should be avoided if it can be helped. But we feel that there is ample production capacity existing with the present manufacturers and any demand for solvent ether would be easily met by these firms already in production. The present high cost of ether in India, apart from climatic disadvantage, makes its use in industry an expensive luxury. This is due principally to the high cost of alcohol prevailing. It has been calculated that if alcohol is available at 6 to 8 annas a gallon, ether of solvent quality can be produced in India to compete successfully with all imported stuff. It must be borne in mind there is heavy loss in transit when ether is imported from abroad. This gives the Indian manufacturers a natural advantage.

Chloroform.—The first meeting of the Panel had set a production target of quarter million lbs. of choloroform per annum for anaesthetic purposes. We feel that for the solvent purposes, another three-quarter million lbs. would be easily consumed.

Carbon Tetrachloride.—The present figure of half a million lbs. of carbon tertrachloride and tetrachloroethylene which has been decided at the first meeting of the Panel should be sufficient and it is presumed that any extra demand needed for the solvent industry can be easily met from the firms that would be producing, the articles for pharmaceutical purposes.

Vynyl Acetate.—This is an important solvent but its most important use is in the production of resins. The production target for this item should be decided in consultation with the Panel on Plastics.

Glycol.—It is felt that for the present a target of 1000 tons should be more than sufficient but here again glycol and glycol acetate are the concerns of other industries such as Aircraft Producton, Paints & Varnishes.

Carbon Bisulphide.—An attempt has been made to produce Carbon bisulphide in India but it has apparently not been successful to any great extent. This is an important solvent for the rubber industry and the panel on rubber should be consulted with regard to the total quantity required. Carbon bisulphide is also used as a starting material for the synthesis of various sulphur compounds.

Sulphur Chloride.—Sulphur chloride is mostly used in vulcanisation. It is not known what are the plans with regard to the rubber industry. But if it is decided to have a worthwhile vulcanizing industry developed in India, it is felt that step should be taken to produce at least.....tons per year. The existing vulcanizing firms use considerable amount of this important chemical whose preparation would not be very difficult if chlorine is available at a cheap cost (sulphur of course will have to be imported).

Benzene & Toluene.—We have already stated that a million gallons of benzene and half a million gallons of toluene are being produced in India. This should suffice for the present, but the production should be kept up.

Nitro-Benzene.—This chemical is used in the perfume industry and also as a solvent in the fine chemical industry. Benzene would be available and the production of nitrobenzene on a large scale would be needed if any plans have been set up for the production of aniline in India. The Committee for Dyestuffs would set up a production target for aniline and we feel that if any production of aniline is undertaken in India, no special arrangements need be made for the production of nitrobenzene.

Xylene.—India's production of Xylene at present is 54 tons per annum. We feel that to start with this would be enough but one possible use to which xylene may be put is as a solvent for DDT. For the latter purpose, very large quantities of Xylene will have to be produced but I am afraid it may not be possible to step up production immediately as Indian coal is carbonised in an unsuitable manner and the yield of xylene is not very high.

Pyridine.—Large quantities of Pyridine would be needed for the manufacture of M.B. 693. Pyridine is also used as a solvent in special cases. We have set a target of half a million lbs. for sulpha drugs. It occurs to me that at least half a million lbs. of Pyridine will have to be produced.

Dioxan.—This will be again a byproduct of ethylene glycol industry. No special target need be set for it.

Glycerine.—India has been producing 2,000 tons per annum. This is many times more than her normal requirement. This will embrace not only her requirements for pharmaceutical and medicinal purposes but also for other industrial uses. At the present moment, owing to the dimunition of defence demands, large stocks of glycerine are accumulating. It is suggested that steps be taken to utilise this glycerine for the production of acroline and various types of resins needed for plastic industry. The Panel on Plastics may be consulted and asked to state their requirement of glycerine for acrylic and glyptol type of resins.

APPENDIX X.

NOTES ON THE MANUFACTURE OF VACCINES, ANTI-TOXINS AND SERA

(Lt. Col., Sir S.S. Sokhey, I.M.S.)

A.—Bacterial Vaccines.

Vaccines.—Since the close of the last century when prophylaxis against bacterial infections, such as plague, cholera, typhoid, with vaccines became possible, Government has organised a number of medical research laboratories, one of whose important activities, among others, is the production of bacterial vaccines. There are at present six such laboratories distributed all over India ; Haffkine Institute, Bombay, (1896), King Institute, Madras (1903), Central Research Institute, Kasauli (1906), the Pasteur and Medical Research Institute of Shillong (1917), the Provincial Hygiene Laboratory, Lucknow, (1931), the Cholera Vaccine Laboratory, Calcutta.

The Government laboratories have, among them a vaccine production capacity of about 8 million cubic centimeters per month. This production can be increased if larger quantities of vaccines were needed. In addition to the existing Government laboratories, it is recommended that all the Provincial Governments should organise these provincial Government laboratories in the near future. These new provincial laboratories should also take vaccine production work and thus increase the vaccine production capcaity of the country.

The present production capacity of the country is ample and is likely to be added to in the near future. No further action is suggested at present.

B.—Rabies Vaccine.

In 1900, Government established the Pasteur Institute of India at Kasauli. Since then all the Government laboratories named in the note above have taken up the manufacture of antirabic vaccine. In addition, Government has established two other laboratories specifically for the preparation of antirabic vaccine and for the administration of treatment ; The Pasteur Institute of Southern India, Coonoor (1907), The Pasteur Institute of Calcutta.

These laboratories are meeting, among them, the needs of the country as regards the vaccine adequately. A large number of treatment centres have already been opened all over the country and there is no doubt that more will be opened as medical relief organisations of the country develop.

C.—Vaccine Lymph.

Vaccine against small-pox is manufactured at seven Government laboratories situated at Ranchi (Bihar), Nagpur (Central Provinces), Guindy (Madras), Calcutta (Bengal), Patwa Dangar (United Provinces), Lahore (Punjab), and Belgaum (Bombay).

These laboratories, among them are meeting the needs of the country adequately. Should demand for more vaccine lymph arise, there is no doubt these laboratories would be in a position to expand their production, or Government will organise more laboratories.

Anti-toxins and Sera.—Until the end of World War I, India depended entirely on foreign imports for its supply of antitoxins and sera. In 1919, a beginning was made by a commercial firm, but it was many years before the firm could produce sera in any quantity. Since then, a number of other firms took up manufacture. In spite of their efforts, large quantities of antitoxins and sera continued to come from abroad.

In 1940, Government organised the production of antitoxins and sera at the Haffkine Institute. This project had two objectives : firstly to put up an ideal set-up for housing the animals and for processing the sera, so that it may set standards for such work in the country and secondly to produce high quality sera in large quantities to make the country independent of foreign imports.

No data are available as to the volume or value of sera imported into the country. Evidently, the Custom Department does not separate sera from other drugs. So it is difficult to say what the needs of the country are, but it is safe to say that because of the small number of hospitals in the country and the very limited resources at their disposal, the quantity of antitoxins and sera used at present is not large. But whatever the demand it is being successfully met at present by the Indian production, as during the war all foreign imports were cut off.

There is no doubt that the demand for sera will gradually increase as the medica relief organisations of the country develop. Against this, it is to be noted that the Madras Government is organising a department of antitoxins and sera production at King Institute, Guindy. It is believed that as Provincial Governments develop their bacteriological laboratory services, they will take up serum production, as in America and Europe. The production of biological products under Government auspices is a well-established practice in the country and Government will take up further production as it becomes necessary. No recommendations require to be made at this stage.

APPENDIX XI (*a*).

Notes on the Equipment for Drugs, fine and Pharmaceutical Chemicals.

(By Mr. N. Adhikari).

Pharmaceutical and fine chemical manufacture covers a very wide field varying from refining of common salt to the manufacture of Penicillin. Inorganic and Organic substances occuring in nature along with many synthetic and semi-synthetic Organic, Organometallic, inorganic, and many biological products are at present employed in medicine. To produce the desired drug or chemical, chemists and Chemical engineers together have to solve many problems both chemical and constructional relating to the isolation or synthesis of the substance in view.

There are many organic compounds which are of plant origin. The manufacture or isolation of these compounds comprises of varying processes of extraction followed by concentration and removal of adherent substances which yield the crude extract or sometimes the pure product. Many substances which used to be regarded as of naturally occurring plant or animal products only, are now successfully and more economically made by synthetic process, as for example l-ephedrine, Adrenalin, Vitamin B1 and C etc. However it is immaterial whether the particular item in view is to be synthesised or extracted from some naturally occuring substances in as much as the manufacturer has always got to solve some problems special for his purpose, only because there are a few standard equipments for the manufacture of even half a dozen of drugs or fine and pharmaceutical chemicals. Almost in all cases plants differ in arrangements and fabrication according to the convenience and particular need of the manufacturer in general and availability of the materials required for the plant in particular. Again, the principles of operation remaining the same the plant for a particular product may be different in different manufacturing concerns depending upon the use of Chemicals as solvents. This is true for the extraction or isolation of substances, but in complete units in operation at different places though engaged in the manufacture of the same product—there is every possibility of finding standard units such as Sulphonators, Nitrators, or Hydrogenators as common components of the plant in which these steps are essential. The manufacturer will have his own extraction or isolation plants made according to his own design—economically fabricated with the materials he can easily secure and suitable to the particular chemical he is going to use. But when the problem of Sulphonation or Nitration is to be worked out it is most likely that one will make use of units made by reputed firms invariably foreign who are in a position to guarantee the life of such equipments under different working conditions by dint of their experience in the line. This is also true for other processes which will require the use of vacuum pumps, super-centrifuges etc. or thermocouples and other precision measuring instruments.

Due to the high standard of purity at which most of the drugs and fine Chemicals are required by regulation, corrosion-resistant equipments are to be employed in most of the operations. Much difficulty is encountered by Chemical engineers in India in constructing such plants for want of proper and suitable corrosion-resistant materials such as Stainless-steel, Monel, Inconel, rubber lined stills and vessels etc. None of these materials, as well as high grade glass Silica or enamel wares which are almost indispensable for any manufacturing concern as ancillaries are made in our country. This is a great handicap to our chemical industry in general and efforts should be made without delay to remove it. India is entirely dependent on her import trade for such capital goods.

For want of proper materials with desired specification our engineers are obliged to use whatever best they can find in the market, which is never upto the mark aimed at and consequently the plants constructed out of them can be seldom worked on for the period it would normally last in case it could be made with materials of correct specification. This in the final tells on the production cost of the drugs and Chemicals concerned. Although several thousand tons of cast iron wares are made in this country for everyday use very few of the firms are agreeable or in a position to make any declaration of the composition of the wares made by them.

If proper materials could be had from abroad or produced here in our country many of standard equipments mentioned before could be made locally. It is not so much the dearth of proper technical skill what stands in the way of making standard appliances here in our country as does the want of proper constructional materials having the specification required by the process. Fabrication has been possible here for machine guns to bridges which are mechanically not very different from fabrication of chemical plants and equipments. In spite of this, big chemical plants have not been built up here. This is due to two factors—one—dearth of materials of choice for the purpose and the other—it has so far not proved worthwhile for big and competent engineering firms to take up this line for want of regular demands from the chemical industry due to its stunted growth.

It has been observed that manufacture of drugs and chemicals—fine and pharmaceutical—involve a series of operations and also that some of these operations are at present carried out with the help of standard equipments imported from abroad. Such units may be classified as under :—

1. Crushers, Ball-mills, Hammer mills, Pulverisers with air separators.
2. Classifiers (screening and separation).
3. Thickners, Clarifiers, Rotary drum filters under vacuum filter processes.
4. Evaporators—Arrangements for using sun-rays, those heated by direct fire (cauldrons, panbaths), those with heating medium in jacket, steam heated evaporators with heating surface in the inside or outside of tubes, plain or under vacuum, single or multiple stage.
5. Centrifuges and Super-centrifuges.
6. Air compressors, centrifugal pumps and other general equipments.
7. Sulphorators, Nitrators and Hydrogenators.
8. Driers—Spray and drum driers for liquids ; Pen, Rotary and Tunnel including tray driers for solids, and vacuum driers.
9. Mixers—gas with gas, gas with liquids, liquid with liquid, liquid with solid, solid with solid ; flow mixers, paddle mixers, propeller mixers, and other different varieties.
10. Deodourisers ;
11. Crystallisers—Classifying
12. Rectifiers, heat exchangers.
13. Refrigerators.
14. Dust catchers.
15. Low temperature distillation equipments (R.C.A. Type).
16. High temperature and pressure working equipments such as, valves, gauges, indicators etc.
17. Acid and Corosion-resistant enamel wares.
18. Glass, silica and porcelain wares.

At present almost all of these equipments are imported from abroad. Much attention has not been paid towards the manufacture of these units here in India for want of proper material in general but particularly for absence of any regular market for them in our country, where there are only very few enterprises which are in need of such appliances and equipments. The cheap man power which was so long been available in this country in abundance, induced the industries to depend more upon it and made them shy of using machineries in places where possible as the latter needed more capital investment at the outset. As a result no attempt was made for mechanisation of any industry thoroughly excepting the major ones. The machine sense of the mass is still very poor but there is some indication at least among the different industries, that people are being alive to the many fold usefulness of mechanisation. Besides, our drug as well as fine and pharmaceutical chemical industries have taken a definite turn towards large expansion, so no time should be allowed to be wasted in taking up the building of our chemical plant

and machinery industry. Much difficulty will not be encountered in manufacturing most of the above equipments here, provided the task of making suitable ferrous and non-ferrous alloys be taken up by the metallurgical industries. Side by side effort should be made to produce electrical machineries suitable to serve the specific duties under abnormal circumstances in the Chemical Plants. Chemical industry depends very much upon electrical power and applicances sometimes as power and sometimes as an essential raw material, and hence full scale development of it (Chemical Industry) cannot be conceived of if this branch of the industry does not grow up simultaneously.

The possibilities of manufacture of standard equipments in our country are as under:—

(1). *Crushers, Ball-mills, Hammer-mills, Pulveriser with air separators.*—These are machines for reducing the size of the raw materials before they are put into the extraction of reaction process. This is very necessary operation in Chemical plants and different machines are employed for different kind of material depending on its physical properties, quantity and feed-size. The physical properties of the main parts of these equipments are very important and should be given due consideration when designing such a machine. The most important parts in such machines are their beaters or rollers which are usually made of special steel alloys. If effort be made to produce necessary alloys for these parts, making of these equipments will not prove very difficult. Air separators which are to be used in conjunction with pulverisers are more complicated in design than material used. It may be somewhat difficult to make these just at present.

(2) *Classifiers*—(Screening and separation).

Making of these is a question of design as well as availability of suitable materials such as wire nettings of fine mesh etc. To skilled technicians it is not likely to be a very hard job.

(3) *Thickness, clarifiers, Rotary drum filters under vacuum, filter pressers.*—Making of these equipments is mostly a matter of design according to necessity and nature of work, and the materials generally used are not scarce except vacuum pumps and its equipments.

(4) *Evaporators.*—Arrangement for using sun-rays, those heated by direct fire (Cauldrons, pan-bath) those with heating medium in jacket, steam heated evaporator with heating surface in the inside or outside of tubes—plain or under vacuum, single or multiple effect:—

When sun-rays are utilised for evaporation it becomes a simple question of making arrangements for exposing a large surface of the solution to it and require little engineering skill or technique. But for making other various types of evaporators necessary for different kind of work it will require much technique both in design and in construction. All the materials largely used in making these are also not available here in the form required. Vacuum pump with its accessories are other components of these appliances. When all these will be available, big engineering firms should take up this line.

(5) *Centrifuges and super Centrifuges.*—Stainless steel and high tensile steel, corrosion-resistant alloys are some of the materials essential for making these equipment. With the materials mentioned above and high speed motor in hand, it will not be very difficult to make some of these applicances of simpler type. The advanced and most up-to-date ones require special designing skill and constructional technique which we lack for the present.

(6) *Air Compressors & Centrifugal Pumps and other general equipments.*—In modern plants these appliances are almost indispensable for transfer of liquors from one stage to another. There is not much of design in them, and it is more a question of having suitable material than anything else to make these especially the pumps. While the compressor may be made out of materials that will be able to stand the pressure desired, the pumps may require special alloys to stand the action of the Chemical as they will come in contact.

(7) *Sulphonators, Nitrators, Hydrogenators.*—Manufacture of these units will be possible when proper cast iron and enamelled-wares will be available.

Enamelled-wares and corrosion-resistant wares play a very important part in modern, chemical industry and these are not only essential for making the above units but they are invaluable in the shape of, concentrators, mixing and stirring of vessels for manufacture of fine Chemicals and Pharmaceuticals. Immediate step should be taken to develop this important industry in our country. This industry again will solely depend on our metallurgical industry whence it is also to have special alloys to stand enamelling.

(8) *Driers.*—Spray and drum driers for liquids ; Pan, Rotary and Tunnel including tray driers for solids, and vacuum driers :—Necessary materials for these appliances are not very hard to procure. Large engineering firms of our country should take up this line of manufacture. There are already a large number of these under use in the different Cement Factories.

(9) *Mixers*—Gas with gas, gas with liquids, liquid with liquid, liquid with solid, solid with solid ; flow mixers, paddle mixers, propeller mixers, and other different varieties-Primary mixing came into use long back but no scientific development has yet been noticed. This subject is not difficult although economical mixing is a problem by itself and needs study.

(10) *Deodourisers.*—This is also a type of appliance that requires more skill in design and that done, the rest will not prove difficult to fabricate by any of the present big engineering firms equipped with modern tools.

(11) *Crystallisers*—Classifying—It is doubtful whether extensive work has been done regarding the development of this appliance in our country. The design of this kind of equipment largely depends on the climate condition of the place of operation. The materials generally used are not very difficult to procure.

(12) *Rectifiers, heat exchangers.*—These equipment are not very difficult to make. Large engineering works of our country should take up the design and construction of these according to the necessity of the manufacturers ; materials required are also available except in few cases of special work.

(13) *Refrigerators.*—If fractional H.P. Motors are available these equipments may be made here but the refrigerant especially the modern ones are to be imported.

(14) *Dust Catcher.*—This equipment though not largely in use up-till now in our country is sure to play an important role in future for reasons of health and also economy and attention should be given to develop it. It is more a question of design to be drawn up according to the problem in hand than anything else.

(15) *Low temperature distillation equipments. (R.C.A. Type).*—These are very modern accessories and though very useful yet, it is not likely that such type of appliances will be made in our country in the near future, unless very special attention is given, to it.

(16) *High temperature and pressure working equipments such as, Valves, Gauges, Indicators etc.*—Much work has not been done in our country in these lines, and as such this side of industry is almost unexplored. So far as we are concerned, high pressure work is coming in the forefront of the chemical industry very quickly and it is the talk of the day. There is much doubt whether we have enough high pressure technicians to design and operate this class of equipments. Before going in for making the appliances needed for this work it will be wise to make special effort to develop high pressure research work in some Government Institute.

(17) *Acid and corrosion-resistant enamel wares.*—This has been discussed under item No. (7).

(18) *Glass, Silica and Porcelain Wares.*—What is true for enamelled wares is also true for this ancillaries. Modern fine chemicals industry in particular and others in general are largely dependent on these wares. This industry has got to be developed immediately on a scientific basis to remove great many troubles associated with our Chemical Industry. Minerals and Chemicals required for these industries are mostly available in India and there should be no difficulty in producing high grade glass, silica and porcelain wares in our country, under proper guidance.

It is to be noted that the above list does not include some common equipments such as :—

(1) Extractors and Percolators.

(2) Ordinary Condensers.

(3) Roasters and furnaces.

(4) Ordinary centrifugal pumps.

(5) Air conditioned chambers.

Which are designed and fabricated here by the manufactureres, according to their necessity. It has also been observed that these appliances cannot be used satisfactorily for the normal period as they are perforce made with low grade materials. Iron sheet, Copper sheets, Aluminium sheets, Brass Sheets and castings of Gun-metal, steam pipes and cast iron pipes, cocks, valves and pipe fittings are some of the common accessories that are mainly used in constructing these plants. To some extent these items are now-a-days made in our country though not always up to the standard in quality. Efforts should be made to improve the quality of these accessories which will go in minimising the production cost of the chemicals to a considerable extent.

It appears that proper training for designing equipments for the Chemicals industry has already been neglected much to the detriment of the Chemical industry and thereby to the health and wealth of the country. Large resources in men and minerals could not be utilised for the good of the country mainly for this reason. It is true that the Chemical industry tried to forge ahead independently but it has now proved to be almost a failure. For the harmonious development of the resources of the country through the Chemical industry, it is imperative to have in the country engineering firms capable of making modern plants and appliances required by the Chemical industry. No planning for Fine Chemicals and Pharmaceuticals is likely to attain great success unless simultaneously the development of Chemical engineering industry is fostered. For this it may be necessary to acquire foreign patent rights for designs and drawings of special plants and equipments to overcome handicap of 50 years which we have already wasted.

APPENDIX XI (*b*).

SUPPLEMENTARY NOTE ON MACHINERY EQUIPMENT.

(By Mr. N. Adhikari).

In my note on the equipment for Drugs, Fine Chemicals and Pahrmaceuticals, I have as far as possible stated which of them could be made here in India. As regards the quantities and cost of different equipments that will be required it is rather difficult to say anyth'ng which may even be called very approximate as different processes are adopted in different countries depending upon the nature of the raw materials available. It will however be more expensive so far as the cost of equipments is concerned if the target figure of production is to be attained by stages than if we aim at establishing factories capable of turning out the same quantities from the starting. For the later purpose, I think a sum of Rs. 120 lacs will be a moderate figure for all the foreign equipments only that might be required for all the items of manufacture in view, including those of synthetic and photo-Chemicals but excepting suplha drugs antimalarials and Penicillin.

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